NEW SERIES, NO. 138 (VOL. XVIII) JUNE, 1922

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Formerly the Quarterly Publication of the American Statistical Association

THE PLACE OF CORPORATE SURPLUS IN THE NATIONAL INCOME[1]

By Oswald W. Knauth

INTRODUCTION

Some years ago Professor David Friday made an estimate of national savings, in the course of which he drew particular attention to the large total of the savings of corporations.[2] The totals which he arrived at were far larger than had been currently believed, both for national savings and for the savings of corporations, and he pointed to the need for further investigation along these lines.

Some time later Mr. W. R. Ingalls, in a series of excellent articles published in the *Times Annalist*,[3] made a similar computation, as a result of which he called into question Professor Friday's large estimates and showed that the amounts actually saved by corporations were about half as large as those shown by Professor Friday. My assignment is a further discussion of the same topic.

Savings are originally made by individuals, corporations, or governments, and are used for more or less durable goods, as opposed to articles immediately consumed. Accordingly their value should show up in any national balance sheet. Such a balance sheet has been drawn up by Mr. Ingalls covering the years 1916 and 1921. He estimates the capital wealth of the country at these two dates respectively at $268,000,000,000 and $270,000,000,000. If his figures are accurate, then in a national sense there was practically no "saving" during this period — all our surplus having been used up directly or indirectly in the course of the war and the economic disturbance following it.

[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

[2] David Friday, *Profits, Wages and Prices*, p. 64.

[3] September 20, 1920.

From an individual viewpoint, however, real saving took place, only it involved a redistribution of the same assets rather than an increase of assets. The individuals who saved and bought Liberty Bonds are richer; but their wealth is in the form of an obligation on the part of the nation, which has to pay taxes to cover interest and has no increased income with which to do it. These savings were no less real because they were expended by the government or lost in the depression of 1920 and 1921, for had they not existed we should be facing an actual impairment of our capital equipment instead of its virtual maintenance. What the nation has today is a heavier mortgage than before the war, mainly in the form of Liberty Bonds, on a practically unchanged base of national wealth. From the individual viewpoint, then, savings by individuals and corporations are quite as real as they were when actually represented by an increase of national assets.

DEFINITION OF CORPORATE SURPLUS

It is well at the outset to give a precise definition of what I mean by corporate surplus.

The surplus of a corporation is that amount of its net earnings which remains after the payment of all expenses, including the various classes of reserves, maintenance charges, taxes, and dividends.

By defining the term in this way we avoid all possibility of including anticipated losses, and bring it down to the actual surplus which is added to the net corporation capital during any period of time. Although this definition is apparently simple, its application in practice is confused by the divergence of methods of accounting among different corporations. The actual conduct of business and the ability of business men to make accurate estimates from year to year vary widely. The reported surplus is nothing more or less than an estimate of accountancy, and is subject to all the limitations and errors which creep into the usage and necessary rules of thumb upon which the principles of accounting are based.

These variations of accounting principles necessitate inquiry into the profit and loss balance sheet of individual corporations. The asset value of the fixed property may be kept at the same amount each year, despite all market changes. The property may be over-maintained or under-maintained. Losses may be written off in one year, or spread over a series of years. From a long-time point of view, these various accounting practices do not make a business actually profitable or unprofitable; but at any particular time, and often for a considerable period, they may distort the picture. An excellent example came to my attention recently. A certain mine had sunk two shafts and

connected them with an underground passage. In the course of time each shaft was enlarged so that they finally joined, and the passage ceased to exist. Nevertheless, in the valuation of the capital assets, for years after, these items were carried as (1) value of shaft No. I, (2) value of shaft No. II, and (3) value of passage. Just as the surplus of each individual corporation is thus open to question, so is the aggregate amount. Whether the statistician's hope that an average may wipe out all particular irregularities is justified will be taken up later. For the moment it can be stated that no particular case or even small group of cases may be considered as typical of the whole. Indeed, the opposite is true, for there seems much evidence for the conclusion that such great classes as mining, manufacturing, and railroads follow quite different practices in accounting.

CORPORATE SURPLUS AND OTHER CAPITAL

In so far as the surplus that is carried on a corporation account as a liability is represented by a real addition to the assets of a similar amount, it is on the same basis as the other liabilities of a corporation. That this is true is recognized in common practice by the frequent interchange of surplus for capital stock. Indeed, the fundamental similarity of all forms of corporate liabilities, surplus, stock, funded debts, notes, and short-time debts, renders possible a considerable amount of interchange through the funding of short-time debts into long-time bonds, the conversion of bonds into stock, and the issuance of stock in place of surplus. These financial expedients have to do with the immediate solvency of a corporation, but they do not alter its assets or its earning power, except in so far as they permit the prosecution of continued policies. From the point of view of representing assets, then, there is no theoretical fundamental difference to be found between surplus and other classes of capital.

The question of the "reality" of the amounts carried as surplus may be tested in a fairly practical way. It has already been pointed out that the practices of corporations vary, not only as between themselves but also from year to year. In order, therefore, to test out a broad generalization, five groups of corporations were found whose records extended over ten years. The ten years chosen were 1905–14 because during this period prices did not move violently. This period was divided into two parts, 1905–09 and 1910–14, and the yearly averages of "capital employed" and "gross business" for each part were found. In this way the peculiar fluctuations of a single year, and to some extent of the business cycle, were removed. The average rise in prices for the second period over the first was 9 per cent—an amount which will not of

itself distort the comparison greatly. At least it is the period of smallest price changes during which adequate published records are available.

If the growth of volume of business is expressed in terms of the percentage of the growth of capital for each of these groups, then the percentages are as follows: 1.08, 1.06, 1.05, 0.98, and 0.90, the average being 1.01⅔ per cent. The indication of this trial, therefore, is that the growth of capital is accompanied by a growth in the volume of business of practically the same extent, and that in so far as surplus is a part of this capital its contribution is the same as any other part. Conclusions drawn from samples are dangerous, however, and this test is only indicative; but it is corroborated in a general way by other data. For instance, when the growth of primary horsepower between 1904 and 1914 is taken as 100, the growth of capital employed in manufacturing reported by the census (a most unreliable figure) is 84.2. I do not place much reliance on this by itself, but in a general way it corroborates the conclusion of a close relation.

In so far, then, as there is any relationship at all between accounting practice and the physical realities which they reflect, my conclusion is that there does not seem to be any reason to question surplus more than the other items in the corporate balance sheet.

With this conclusion Mr. Ingalls disagrees. He emphasizes the losses which are incurred by every going business, and considers that a proper discrimination will show that surplus in many cases is closely akin to a reserve account rather than an increment to capital. This is a generalization very difficult to prove or disprove, especially in a period of such wild price fluctuations as we have recently passed through. It is, finally, an accounting problem, and accountants have been having a difficult time in their attempts to give a true valuation of assets and liabilities.

The writing down of assets in 1921 has proceeded regardless of distinctions between surplus and capital on the balance sheet; and I should rely on an accurate accounting of real surplus in the year it occurred—to be wiped out, if necessary, by loss in the year when it occurs—rather than on a leveling out of income which minimizes both gain and loss.

Perhaps the above contention requires some modification. That corporate surplus is not considered to be quite on a parity with other forms of capital is indicated by the uses to which it is put by directors. They are more likely to take "fliers" with their surplus than with their capital; often these "fliers" prove disastrous. Ornaments to buildings or factories, hazardous advertising campaigns, experiments, questionable extensions of plant, and waste effort of various kinds are not

undertaken until they can be paid for out of surplus. There is some information that points to the possible conclusion that the return per dollar on surplus is less than on paid-in capital.

For quite another reason this smaller return is typical of public utilities. Although it is difficult to generalize, I venture the statement that only rarely do commissions allow an increased rate sufficient to yield an adequate return on the surplus put back into the property.

Another difference is that surplus is commonly used as a buffer to business losses. It is the first item, after specific reserves, to be written off. There is scarcely a corporation that has not been forced to take large losses of this kind in the last year or two. Does this mean that these amounts were not earned in the first place, and should never have been considered as part of the capital? Clearly not, because the gains of yesterday were no less real because there are losses today; indeed, it would not have been possible to write off these losses without impairment of capital unless the previous gains had been there. To refuse to take account of real income in any year because it may be lost in the future would give a false picture. It would show a more uniform total income in each year than is actually realized.

THE PERCENTAGE OF REAL SAVINGS

Taking into consideration the results of the inquiry noted above, and putting with these results common knowledge, I believe it is safe to conclude that between 80 and 90 per cent of the reported surpluses may be considered to be real savings. The evidence might be construed into an even higher percentage, but the unknown factors of possible losses are such as to make an understatement preferable, rather than to take chances on an overstatement. For purposes of computation, 85 per cent of the reported surplus has been used.

In this connection a further element of uncertainty should be pointed out. The practice of forming private investment corporations for the purpose of avoiding personal income tax has increased tremendously since the armistice. Concerning these corporations no generalized information is available. Every one must depend on the few samples that may come in his path. It appears probable that during the war personal income taxes were reported without a great deal of evasion, but since the armistice technical devices for evasion have multiplied at an astonishing rate. Among these is the formation of private investment corporations which retain all their earnings except such as are necessary for the living expenses of their stockholders. What the surpluses that are put aside in this way may amount to it is impossible to state. But they are doubtless large.

And the argument that income taxes are not evaded but are merely postponed will not hold; for it is in the hope that the present high rates will be materially reduced that these methods are practiced. It may be that this affords a partial explanation for the reduction in large incomes reported by the Bureau of Internal Revenue. The number of persons reporting incomes over $100,000 for 1916 and 1919 are respectively as follows:[1]

1916	6,633	1918	4,499
1917	6,644	1919	5,526

During this period the total number of income taxpayers was increasing rapidly. It is difficult to know what effect to ascribe to this one cause, for there were so many other influences at work—some of which also tended to reduce the reporting of large incomes—that the matter is confused beyond the possibility of close analysis. But there seems little doubt that legal evasion through the formation of private corporations was one of the strong influences at work. This applies especially to the 1918 and the 1919 returns after the war was over. One would have expected, in view of the rise in prices, an increase of large incomes over 1917 and perhaps over 1916. The probabilities are, therefore, that the surpluses retained by private corporations are greater in proportion than those of the business corporations which have been used as samples in this report.

THE METHOD OF ESTIMATING TOTAL SURPLUS

The method employed for estimating the total surplus which corporations laid aside in each year was as follows:

Sample corporations, based on the ability to find adequate records over a period of years, were used for each industrial division, and the amounts actually paid in dividends and carried forward as surplus were recorded. No reserves of any kind were included in this surplus.

The number of corporations used as a sample were as follows:

Industrial	205
Public Utilities	62
Commercial	15
Banking	Reports of Comptroller of the Currency
Railroads	Reports of Interstate Commerce Commission

The percentage divisions between dividends and surplus for each group were weighted in accordance with the total earnings of that group, and the average percentage division found for each year. This percentage was then applied to the total net earnings of corporations as reported by the Bureau of Internal Revenue, and adjusted to accord

[1] *Statistics of Income*—1916-7-8-9.

with changes in the law. These adjustments covered: (1) The reporting at first only of corporations having a net income over $5,000, and later of all corporations; (2) the inclusion or exclusion of intercorporate dividends, the method being changed several times; (3) the non-reporting of deficits in the earlier years and their inclusion in the later; (4) the collection of back taxes after an audit which indicated total income for a past year greater than at first reported.[1] An estimate that was frequently a "best guess" was made for each of these items in each year, and the resulting total used.

The percentages of earnings paid out as dividends and hence also the percentages retained as surplus by the different industrial groups showed a wide variation, and the percentages for each group fluctuated greatly as between years. Financial corporations in 1915 paid out 89 per cent of their earnings as dividends, as against 52 per cent in 1920; manufacturers paid 79 per cent of their earnings in 1914, as against only 37 per cent in 1916; public utilities had their lean period in 1918, when they paid out 87 per cent of their earnings, as against 61 per cent in 1910; and railroads in 1914 paid 92 per cent of their earnings, as against only 42 per cent in 1916.

The full table showing the proportions of net earnings paid as dividends and retained as surplus in each class of corporations for each year, is as follows:

THE PROPORTIONS INTO WHICH NET EARNINGS ARE DIVIDED BETWEEN DIVIDENDS AND SURPLUS

(D=Dividend; S=Surplus)

Year	Financial institutions[a]		Commercial[b]		Manufacturing and Mining[c]		Public Utility[d]		Railroads[e]		Weighted average	
	D	S	D	S	D	S	D	S	D	S	D	S
1910[a]	69	31	55	45	55	45	61	39	62	38	58.8	41.2
1911	73	27	63	37	63	37	68	32	72	28	66.6	33.4
1912	81	19	67	33	67	33	73	27	82	18	71.9	28.1
1913	74	26	67	33	67	33	74	26	73	27	69.5	30.5
1914	81	19	51	49	79	21	76	24	92	8	77.9	22.1
1915	89	11	44	56	45	55	67	33	86	14	56.2	43.8
1916	73	27	34	66	37	63	63	37	42	58	42.7	57.3
1917	65	35	41	59	47	53	75	25	52	48	50.2	49.8
1918	61	39	49	51	55	45	87	13	65	35	56.9	43.1
1919	56	44	35	65	56	44	81	19	56	44	63.1	36.9

[a] Based on National banks. Reports of the Comptroller of the Currency.
[b] Based on 15 Commercial Corporations reported in Moody's Manual from 1914 to 1919. Previous to 1914 the reports are inadequate, and the manufacturing ratio is used.
[c] Based on 205 Corporations, reported in Moody's Manual and supplied by certain banking institutions. These ratios are also applied to "Miscellaneous" Corporations.
[d] Based on 62 Public Utility Corporations, reported in Moody's Manual.
[e] Based on reports of Interstate Commerce Commission and reports in Moody's Manual, covering practically all railroads.

[1] For full details, see *Income in the United States*, Vol. II, Chap. 25, published by the National Bureau of Economic Research.

With the limitations both of definition and of the possibility of accurate measurement in mind, the surplus of all corporations for each year since 1910 may be estimated as follows:

	Million dollars		Million dollars
1910	1,200	1915	1,600
1911	900	1916	3,900
1912	900	1917	3,400
1913	1,000	1918	1,700
1914	500	1919	2,000

In 1920 the figure is probably about one billion dollars, and a guess at 1921, made from a variety of advance estimates and partial earnings, puts the figure at less than one-half billion dollars.

In terms of percentage of the national income, we have an extreme range from less than 2 per cent in 1914 to 8 per cent in 1916, with a normal of about 4 per cent. Our total savings seem to be about 15 or 16 per cent of the total income according to a recent estimate by Mr. Willford I. King; and corporation saving is about one fourth of the total. It is therefore a highly important item.

ECONOMIC EFFECTS OF THE RETENTION OF SURPLUS

The policy of retaining a part of the corporate earnings appears to have grown up without any real thought of its fundamental effects. Today it is taken for granted that no corporation shall pay out more than a fraction of its earnings. Probably the first idea was to ensure dividends for the lean years. It is a matter of pride to point to an unbroken dividend record, and annual changes in the rate are not desired by any one; but surpluses are not retained entirely in the liquid form necessary to ensure the fixity of dividends, being often used to increase the fixed assets.

What have been the effects of this policy, especially as compared to the opposite policy of automatically paying out all the earnings each year?

The stabilization of dividends leads to a more certain return to the stockholder than would varying rates, and gives to many securities an appearance of being semi-investments through the actual payment of the same rate of dividends over a considerable period of time. Many securities do not really possess this quality. Examples of this are sufficiently familiar to all of us. But it has more important aspects than this: (1) It gives to the managements unobstructed control of new funds which amount normally to one fourth of the total national savings; and (2) it makes it very difficult for an outsider to judge the

real value of a concern. Both of these results are incidental to the increased stability which this unconscious form of saving brings about; yet they affect the business structure to a marked degree.

The reinvestment through surplus in copper mining brought that industry into a serious crisis of over-production. Between 1915 and 1918 practically no outside money was put into copper mining in this country, Anaconda being the only company that sought new funds, and this largely for extension in other fields. In the same period, smelting capacity increased from 20 million tons of ore to 22½ million tons; refining capacity increased 58 per cent, or from 1,768 million pounds to 2,794 million pounds; and copper production rose from 1,250 million pounds to about 2,000 million pounds, or 60 per cent. These increases were due almost entirely to the reinvestment of the large war earnings. Probably the public could not have been persuaded to subscribe the new money for them so easily as were the over-enthusiastic managers. A similar condition occurred in zinc mining, and to a less degree in iron and steel. This magnified desire of American business men to expand their business at the expense of personal savings and even comforts has become a national characteristic in the same sense that family thrift and saving is strikingly exemplified in France.

IS CORPORATE SURPLUS REFLECTED IN STOCK QUOTATIONS?

There naturally arises the question as to whether corporation surpluses are not accurately reflected in the quotations of the stocks of companies, and whether they do not in this way become a part of the incomes of individuals who own these stocks. If this be the case, then an inclusion of corporate surplus as a separate part of the national income which is added to the incomes of individuals would bring about a double-counting, provided that individuals sold their stocks.

Although this might be the case it probably was not during the last four years, for the following reasons: (1) The great rise in income tax rates caused many persons to refrain from selling stocks which had advanced in price; (2) the amounts reported by the Bureau of Internal Revenue as "income from sales of investments" are surprisingly small —1917, 316 million dollars, and 1918, 291 million dollars; and (3) the increase of stock values in 1919 was due not so much to the retention of surpluses as to the enhanced value of all prices of materials on hand and the expectation of permanently larger profits. For the most part, it appears likely that stocks and property were retained by their owners long enough for them to watch their values fall off in 1920 and 1921. The proposed high tax rates will probably continue to operate against

the cashing in of profits due to an increase in property values; but if the rates are lowered, it may well be that this judgment will have to be revised.

CONCLUSIONS

1. The policy of corporations in retaining part of their earnings leads to important national savings.

2. The amount of these corporate savings varies widely from year to year according to the prosperity or the depression of business.

3. These savings constitute about one fourth of the total savings, and about 4 per cent of the national income.

4. They are far more than stabilizers of dividends in that they largely increase the power of the managements of corporations in guiding the growth of industries in this country.

A SUMMARY OF THE RESULTS OF THE 1920 CENSUS OF AGRICULTURE[1]

By Leon E. Truesdell

INTRODUCTION

The general policy adopted for the Fourteenth Census was to make available the results of the census as early as possible, with little or no attempt at analysis or even at explanation, except where explanation was absolutely necessary to the understanding of the figures. In other words, the main task assigned to the Census Bureau was to supply the raw material, and to make it available for the use of other agencies in the shortest possible time. In this paper I shall present a few samples of this statistical material, with suggestions as to their possible significance.

NUMBER OF FARMS AND FARM ACREAGE

The total number of farms reported for 1920 was 6,448,343, which represents an increase of only 1.4 per cent over the number of farms reported in 1910. This slight net increase is the result of considerable gains in some of the western and northwestern states, partly offset by losses in most of the older agricultural states. In the state of Montana, for example, there were more than twice as many farms in 1920 as in 1910. In Wyoming the increase was 43.3 per cent; in Idaho, 36.7 per cent; in California, 33.4 per cent; and in Colorado, 29.8 per cent. These increases were largely offset by decreases in the number of farms in all of the states east of the Mississippi River and north of the Ohio, except Wisconsin.

The total area of land in farms increased from 878,798,325 acres in 1910 to 955,883,715 acres in 1920, a gain of 8.8 per cent. The increase in acreage, like that in number of farms, was the net result of a large increase in the western part of the country, partly offset by decreases in the East.

In several of the eastern states, notably in New England, the decrease in the number of farms and in the farm acreage revealed by the census of 1920 is only a continuation of the decrease which has been going on for two, three, or more decades. To some extent, at least, the decrease in these states represents the giving up of farm land which

[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

cannot be profitably operated under present conditions, or of what might be termed sub-marginal land. Some of this land would have been given up long ago if its owners had realized its unprofitableness. Much of it is now growing up to timber, and it will prove more profitable for this purpose than it has been for agriculture in recent years.

FOREIGN-BORN FARMERS

The total number of foreign-born farm operators in the United States decreased from 669,556 in 1910 to 581,068 in 1920, or 13.2 per cent. The number of farm operators who were born in Germany alone declined from 221,800 in 1910 to 140,667 in 1920, a decrease of 81,133, or 36.6 per cent. Notable decreases were also shown in the number of farm operators born in England, Scotland, Wales, Ireland, and Canada. In all these cases it may be presumed that the principal cause of the decrease was the fact that the men returned to their native countries for war service. On the other hand, there were considerable increases in the number of farmers from the Netherlands, Poland, Hungary, Russia, and Italy.

FARMS BY TENURE

Of the total number of farms in the United States in 1920, 2,454,804, or 38.1 per cent, were operated by tenants, as compared with 37 per cent in 1910, 35.3 per cent in 1900, 28.4 per cent in 1890, and 25.6 per cent in 1880. It thus appears that while the percentage of farms operated by tenants is still increasing, the increase during the last decade was not so great as that which took place in any of the earlier decades for which figures are available.

In all of the states of the New England and Middle Atlantic divisions there was a decrease in the percentage of tenancy, continuing a tendency which has been evident since 1900 or earlier. In some of the states of the far West there were considerable increases in the percentage of tenancy, though even now both percentage and actual number of tenant farms are small. The percentage of tenants among the farmers in North Dakota increased from 14.3 in 1910 to 25.6 in 1920; in South Dakota from 24.8 to 34.9; and even in Iowa the percentage increased from 37.8 to 41.7. In the South as a whole the percentage remained unchanged at 49.6, and among the 16 southern states only 6 showed an increased percentage of tenants.

In the existing economic conditions there are several factors which would normally tend toward a continued increase in tenancy. The supply of free land is exhausted, and the rapid advance in farm-land values during the past 20 years has made it increasingly difficult for a

young man to become a farm owner. Perhaps, then, instead of feeling pessimistic because there were 100,128 more tenant farms in the United States in 1920 than there were in 1910, one should feel optimistic because the increase has not been 200,000 or 300,000.

NEW TENURE CLASSES IN THE SOUTH

In the census of 1920 two new tenure groups were added to the classification of farms by tenure in the southern states. Standing renters were separated from cash tenants, and croppers were separated from other share tenants.

Standing renters were defined as tenants who paid for the use of the land a fixed quantity of some product, rather than an amount in cash. The number of standing renters in the South in 1920 was 104,996, and the number of cash tenants, 219,188.

The most important difference between the cropper and the regular share tenant lies in the greater degree of supervision exercised by the landlord in the case of the cropper. As a convenient means of classification, however, croppers were defined as share tenants to whom the landlord furnished the necessary work stock. The number of croppers in the South was 561,091, and the number of regular share tenants, 651,224.

It has been claimed by some writers that croppers ought not to be considered as tenants at all, but rather as hired hands receiving their payment in the form of a share of the crops in place of a stated wage. Although the conditions hardly seem to justify this contention, it is interesting to note what would be the result of a reclassification in which croppers were considered simply as hired hands. The percentage of tenancy in the South in 1920, including the croppers, was 49.6; excluding the croppers both from the number of tenants and from the total number of farmers, the percentage would be 38.9. In the state of Georgia, which in 1920 showed the highest percentage of tenancy among all the states in the United States, the percentage would be reduced from 66.6 to 51.3 if the croppers were excluded. Even with the croppers excluded, however, several other southern states in addition to Georgia would still have higher percentages of tenancy than any of the northern states, among which Nebraska, with 42.9 per cent, and Illinois, with 42.7 per cent, show the highest proportion of tenants.

FARM VALUES

The value of all farm property in 1920 was $77,924,100,338, as compared with $40,991,449,090 in 1910. This represents an increase of $36,932,651,248, or 90.1 per cent, during the decade. The absolute

increase, nearly $37,000,000,000, is certainty big enough to warrant careful consideration, even in these days when values are frequently counted in billions. On a relative basis, however, the increase of 90.1 per cent is less than the increase between 1900 and 1910, which amounted to 100.5 per cent, and considerably less than the increase in the general price level between 1910 and 1920, which was 146 per cent, according to the wholesale price index of the Bureau of Labor.

The increase in farm real estate values, of course, is the principal factor in the increase in the value of all farm property. The value of farm land and buildings in the United States increased 109.5 per cent between 1900 and 1910, and 90.6 per cent between 1910 and 1920. Taking the figures for the average value per acre, in order to eliminate the effect of any increase in farm acreage, it appears that the average value of farm land and buildings per acre of land increased from $19.81 in 1900 to $39.60 in 1910, or 100.2 per cent, and again to $69.38 in 1920, an advance of 75.1 per cent over the value in 1910.

The fact that the average value of farms per acre in the country as a whole increased only 75.1 per cent in the 10 years ending with 1920, as compared with an increase of 100.2 per cent in the 10 years ending with 1910, is especially significant in view of the fact that the general price level increased to a much greater extent between 1910 and 1920 than it did during the preceding decade. Further, the increases shown in the 1920 figures for several of the corn belt states (forming a material part of the increase in the United States as a whole) may be attributed in part to the wave of speculation which swept over that part of the country during 1918 and 1919. The states showing especially high percentage increases in the value of land per acre also include a number of cotton states. And both in the corn belt and in the cotton states the present low prices of farm products have already brought about great reductions in real estate values.

Taking all the circumstances into consideration, then, the figures which by themselves appear to represent such a great increase in farm values in 1920 really indicate a halting in the upward tendency which these values have shown since 1850.

Theoretically, the value of the farm land in any country increases in proportion to the number of inhabitants to be supported per 1,000 acres of cultivated land. As a matter of statistical record, however, the number of inhabitants in the United States per 1,000 acres of improved land shows only a slight net increase since 1850. In 1850, when the average value of farms per acre was $11.14, there were 205 inhabitants per 1,000 acres of improved land in farms; in 1910, when the average

value of farms per acre was $39.60, there were 192 inhabitants per 1,000 acres of improved land, or actually fewer than in 1850; and in 1920, with farms valued at $69.38 per acre, there were only 210 persons per 1,000 acres of improved farm land. The theory, then, has not worked out in the experience of this country up to the present time.

The expectation of a continuous increase in the value of farm land has come to be a fixture in the minds of American farmers, and in many sections it is a fundamental part of the prevailing scheme of farm economics. If the farm income above the amount equivalent to fair wages for the farmer is considered as interest on the farm investment, it seldom amounts to more than 3 per cent. The average annual increase in the value of the farm for the past 20 or 30 years, however, in many parts of the country has been 6 or 7 per cent. The 3 per cent of actual operating income plus the 6 or 7 per cent of increase in value has made up a fairly satisfactory total income on the investment.

It has been evident to many economists studying the problems of farm economics that this increase in the value of farm land could not go on forever. The increases since 1900 have been assisted by a rapid increase in the general price level; in fact, the increase since 1910 has not kept pace with the increase in the general price level. Looking forward, then, as we probably must, to a long period of declining prices, how can we expect the value of farm land to go on increasing?

The farm whose operating income now pays 3 per cent on its purchase (or market) price will have no other source of income by way of supplement. In fact, if the market value of the land declines, the decrease in the selling value of the farm from year to year may even exceed the net operating income. What effect will this have on the rental charged for the use of farms operated by tenants? Such farms constitute a considerable percentage of the total number of farms, both in the South and in the Middle West. The rentals charged now are high enough to make it fairly difficult for the tenant farmer to obtain a satisfactory income. Suppose they were to be suddenly doubled in order to make up for the lack of any further speculative profit from the rise in land values. What would then become of the tenants?

And what are the prospects of the farm owner who has profited greatly during recent years, whether he has realized it or not, from the speculative increase in the value of his land holdings? These are serious questions—questions for the agricultural economist, however, rather than for the statistician. Nevertheless I will venture one suggestion—that the solution of the problem will come chiefly through increased efficiency in the conduct of farming operations.

MORTGAGED FARMS

The census figures relating to farm mortgages are limited to those farms which are operated by their owners, no attempt being made to secure mortgage data for farms operated by tenants or managers. The reason for this restriction is that the tenant or manager in very many cases would not know whether the farm was mortgaged or not, and he would be even less likely to know the amount of the mortgage debt.

The total number of farms operated by their owners in the United States in 1920 was 3,925,090. Of these farms 1,461,306, or 37.2 per cent, were reported as mortgaged, as compared with 33.2 per cent in 1910.

The figures representing the amount of the mortgage debt relate only to the farms operated by farmers owning all the land which they operate. This limitation is made necessary by the difficulty of ascertaining the value of that part of the farm covered by the mortgage in cases in which the farmer owned a part of the farm and hired a part of it.

The amount of the farm mortgage debt reported was $4,003,767,192 in 1920, as against $1,726,172,851 in 1910. The increase in the amount of debt was $2,277,594,341, or 131.9 per cent, while the value of the mortgaged farms increased only 117.6 per cent during the same period.

The value of the farms for which the amount of mortgage debt was reported in 1920 was $13,775,500,013. The debt therefore represented 29.1 per cent of the value, as compared with 27.3 per cent in 1910.

The average rate of interest paid on farm mortgages in 1919 was 6.1 per cent. This item has not been secured in any previous census except that for 1890. The rate then, obtained in a different way but approximately comparable, was 7.07 per cent.

The increase in the number of mortgaged farms or in the amount of mortgage debt does not necessarily indicate any lack of prosperity, since the money is borrowed in many instances for profitable investment in improvements or in the purchase of additional land. A large part of the total doubtless represents the balance due on the purchase price from recent purchasers who paid a part of the price of the farm and gave a mortgage for the rest. Aside from this item, however, the increase in the mortgage debt presents one aspect radically different from the increase in the value of any class of farm property. The value of the farm may double in a decade without making any very material change in the routine of the farm business. That is, the increase may be simply on paper, so to speak. The increase in the mortgage debt, however, aside from the item just referred to, means that the farmers have received and spent for some purpose actual money to the amount

of the increase. Since the amount of the increase in the farm mortgage debt on owned farms alone between 1910 and 1920 was more than $2,000,000,000 one may well ask what the farmers did with the money.

MOTOR VEHICLES, TELEPHONES, WATER, AND LIGHT

Among the new inquiries on the 1920 farm schedule, one that has aroused a great deal of interest relates to the number of farms having motor vehicles, telephones, water, and gas or electric light. According to the returns, 30.7 per cent of all farms in the United States in 1920 had an automobile. Some farms, of course, had more than one, but the significant figure is the number of farms which had at least one. Two per cent of all the farms had a motor truck, and 3.6 per cent a tractor. A telephone was reported by 38.7 per cent of the farms, water piped into the house by 10 per cent, and gas or electric light by 7 per cent.

VALUE OF LIVE STOCK

The value of all live stock on farms on January 1, 1920, was $8,013,324,808, as compared with $4,925,173,610 on April 15, 1910. The value of the live stock thus shows an increase of 62.7 per cent, which is a smaller relative increase than that shown by any of the other classes of farm property—either land and buildings or implements and machinery. The value of horses, the most important of the domestic animals in point of value in 1910, shows an actual decrease of $301,510,708, or 14.5 per cent.

The average value of horses per head decreased from $105.06 in 1910 to $90.15 in 1920, and the average value of mules increased only from $124.80 to $143.45. In contrast with the decrease in the average value of horses and the slight increase in the value of mules, the several kinds of meat animals (cattle, sheep, and hogs) show average values for 1920 more than double those of 1910.

HORSES AND MULES

The number of horses on farms reported for January 1, 1920, was 19,767,161. The number of horses reported for April 15, 1910, was 19,833,113 including 612,775 spring colts. If we compare the numbers as reported, the 1920 figures show a decrease of 65,952, or 0.3 per cent. If we deduct the spring colts from the 1910 figures, on the ground that they could not have been counted on the first of January, since they were not then in existence, the figures show an increase of 546,823, or 2.8 per cent. The actual increase was somewhat less than this, however; for the number of mature horses (or horses and yearling colts)

would be smaller in April than in January, since some would have died during the intervening months. These would offset, in part, the number of spring colts born between January and April.

The number of mules on farms on January 1, 1920, was 5,432,391, as compared with 4,209,769 on April 15, 1910. Making the comparisons in the same way as for the horses, the minimum increase in the number of mules was 1,222,622, or 29 per cent, and the maximum increase was 32.5 per cent. Between these two figures—perhaps about half-way between—lies the actual increase.

CATTLE

The number of cattle on farms in the United States on January 1, 1920, was 66,652,559, while the number on April 15, 1910, was 61,803,866, including 7,806,539 spring calves, which would not have been reported, of course, if the 1910 census had been taken in January. On the other hand, a census taken in January would have included the large number of cattle which were marketed or slaughtered during the first three and one-half months of the year. The two factors affecting the comparability of the figures for 1910 and 1920 are about the same, then, as with the horses and mules, except that the margin between them is much greater. The total number of cattle reported for 1920 exceeds the total number for 1910 by 4,848,693, or 7.8 per cent. The total number of cattle reported for 1920 exceeds the number in 1910, omitting the spring calves, by 12,655,232, or 23.4 per cent. The minimum percentage of increase is 7.8, and the maximum is 23.4. The actual increase is less than the maximum by the number of cattle slaughtered or marketed by farmers between January 1 and April 15, 1910.

The change in the date of enumeration probably affected the number of dairy cows much less than it did the number of all cattle, but there was also a change in the age classification. Dairy cows in 1910 included all cows and heifers over 1 year of age on January 1 of the census year, while dairy cows in 1920 included only those cows 2 years old and over on January 1 of the census year. The number of dairy cows 2 years old and over reported for 1920 was 19,675,297, and the number of dairy heifers 1 year old and under 2 years was 4,048,851. There were thus 23,724,148 dairy cows and heifers 1 year old and over, as compared with 20,625,432 in 1910. This gives an increase of 3,098,716, or 15 per cent. In considering the absolute increase, however, it should be remembered that this includes yearling heifers. The increase in dairy cows 2 years old and over would be about 2,550,000.

PURE-BRED LIVE STOCK

Pure-bred live stock of some kind (either horses, cattle, sheep, or swine) was reported in 1920 by 693,724 farms, or 10.8 per cent of the total number in the United States in 1920. Of the total number of horses on farms, 0.6 per cent were reported as pure bred; of the cattle, 3 per cent; of the sheep, 1.3 per cent; and of the swine, 3.5 per cent.

DAIRY PRODUCTS

The value of dairy products of farms in 1919, including butter and cheese made and milk, cream, and butter fat sold, was $1,481,462,091, as compared with $596,413,463 in 1909, thus showing an increase of 148.4 per cent. A large part of this increase, of course, was the result of higher prices; but after making allowance for an increase of 115 per cent in the prices of dairy products, there still remains an increase of 15.5 per cent in the production.

The quantity of milk produced in 1919, including estimates for farms which reported dairy cows on hand but failed to report their milk production, was 7,805,143,792 gallons, which represents an increase of about 18 per cent over the production of 1909.

The production of butter on farms in 1919 was 707,666,492 pounds, as compared with 994,650,610 pounds in 1909. The decrease (amounting to 28.9 per cent) in the farm production of butter was more than made up, however, by an increase in the factory production. Incidentally, the 1919 figures indicate that the movement of butter production to the factories and away from the farms is still making rapid progress. In 1899 only 28.2 per cent of the total production of butter was made in factories; in 1909, 38.6 per cent; and in 1919, 56.5 per cent, or considerably more than one half. And if only that butter which is produced for sale is considered—taking the amount of butter *sold* by farmers, in place of the total quantity *made* on farms—it appears that 81.6 per cent of the commercial production of butter in 1919 was made in factories and only 18.4 per cent on farms.

CROPS IN GENERAL

The total value of farm crops harvested in 1919 (not including forest products) was $14,755,364,894, as compared with $5,231,850,683 in 1909. These figures represent an increase of $9,523,514,211, or 182 per cent, for the decade. In other words, the value of all farm crops in 1919 was nearly three times the value in 1909. This enormous increase in the value of crops is due mainly, however, to the fact that the prices of crops were unusually high in the year 1919. A tabulation of the quantities of all the important crops harvested in 1919 with values computed

on the basis of the 1909 prices indicates an increase of only 9 per cent. So much of the increase in value, therefore, may be attributed to increased production, and the remainder to higher prices.

The index of the census prices of all farm crops in 1919, taking the values of 1909 as 100, is 257, and the index for crops and live-stock products together is 248. The latter index is only a little higher than the Bureau of Labor's index of wholesale prices of farm products which, as computed for the same years, was 241.

The total acreage of all crops harvested in 1919 for which acreage was reported was 348,551,669, as compared with 311,194,516 acres in 1909, representing an increase of 12 per cent.

PRINCIPAL CROPS

The acreage of corn harvested in 1919 (not including silage or corn cut green for fodder) was 87,771,600, as compared with 98,382,665 in 1909. The acreage of wheat on the other hand increased from 44,262,592 in 1909 to 73,099,421 in 1919. There was thus a decrease of 10,611,065 in the acreage of corn and an increase of 28,836,829 in the acreage of wheat. To a considerable extent, without doubt, the increase in the wheat acreage was the result of a temporary condition, namely, the guaranteed price for wheat for the crop of 1919; and under present conditions several million acres of this land are doubtless again used for raising corn.

The production of corn in 1919 was 2,345,832,507 bushels; of wheat, 945,403,215 bushels; and of oats, 1,055,182,798 bushels. These three crops constitute the bulk of our cereal production.

The production of hay and forage in 1919, not including 17,793,742 tons of corn cut for forage, was 128,549,499 tons, as compared with 97,755,296 tons in 1909, an increase of 12.8 per cent. The production of silage crops in 1919 was reported by 378,887 farms, or 5.9 per cent of all farms in the United States. The acreage in silage crops was 4,003,226 and the production 29,682,041 tons, which was more than three times the production in 1909.

The production of tobacco increased from 1,055,764,806 pounds in 1909 to 1,372,993,261 pounds in 1919, or 30 per cent, and the production of cotton increased from 10,649,268 bales to 11,376,130 bales, or 6.8 per cent.

SUMMARY

By way of summary three or four outstanding features in the results of the farm census of 1920 may be mentioned. There have been considerable increases in the number of farms and in farm acreage in the West and the Northwest, partly offset by decreases in the eastern states.

The increase in farm values between 1910 and 1920, although very great in absolute amount, represented a smaller percentage for the decade than did the increase between 1900 and 1910. This fact, taken in connection with the enormous increase in the general price level during the past decade and other existing conditions, is believed to indicate that the value of farm property reached a peak in 1920 and that further increases should not be expected in the immediate future. The farm mortgage debt, as measured by the debt on farms operated by their owners, considerably more than doubled between 1910 and 1920. Crops and live-stock products showed some increase in quantity during the ten years ending with 1919, but the large increases in value were due mainly to increased prices.

DISCUSSION[1]

By C L. Stewart

There is danger that the country may be lulled to indifference by reports that the rate of increase of farm tenancy in the United States is rapidly diminishing. It is true that the number of tenant farms per thousand grew from 353 in 1900 to 370 in 1910, an increase of 5 per cent, whereas from 1910 to 1920 the number grew from 370 to 381, an increase of only 3 per cent. When measured on the basis of acreage and value, however, the number of rented acres per thousand and the number of dollars worth of rented land per thousand was not only higher than that shown on the preceding basis, but has been growing at much faster rates during both of the decades since 1900, especially during the decade just ended. While the proportion of rented farms increased but 3 per cent between 1910 and 1920, the proportion of leased property values and of leased acreage increased 11 per cent.

In other words, the tenure of American farm real estate cannot be correctly stated in terms of farms only. In most sections farms operated by tenants differ in size and value from farms of other operators. Furthermore, parts of farms are hired by so-called "part-owners." These can properly be accounted for as operators of tenant realty only in statistics of acreage and value.

In 1920 part-owner tenancy involved 89 million acres and nearly 4 billion dollars worth of land and buildings. At the same date "full" tenancy claimed 265 million acres and nearly 24 billion dollars worth of land and buildings. Altogether 354 million acres and nearly 28 billion dollars worth of land and buildings were operated by lessees.

To reduce the lessee acreage and values to percentages of all farm

[1] Also read at the Pittsburgh meeting.

acreage and values, the 54 million acres and nearly 3 billion dollars worth of property in farms operated by managers may be either included or excluded. The employers of managers do not in all cases own all the land and buildings they commit to the custody of their representatives, but they can be classified as owners, part-owners, and tenants, as are operators of farms under more direct operation. Since our statistics of tenure bear only on directly operated real estate, for some purposes it is desirable to express the lessee percentages for non-manager property only, even though the result is to reduce the showing of operating owners and increase that of lessees.

Without excluding property in farms operated by managers, the percentage of acreage operated by lessees in 1920 was 37, and the lessee percentage of land and buildings as measured by value was 42. Omitting real estate operated by managers, lessees operated 39 per cent of the farm land as measured by acreage and 44 per cent of the total valuation of farm land and buildings. On this basis lessees in 1920 operated 44 per cent of the improved acreage and 46 per cent of the value of land alone.

Since the proportion of agricultural property operated under lease falls short of the half-way mark by such a narrow margin for the United States as a whole, it is not surprising to find that in some areas the half-way mark has been passed. Without excluding property in farms of managers, over half the acreage of all land was leased in 2 states, Delaware and Illinois, both in 1910 and in 1920, with a tendency toward increase in Illinois. If improved land alone is considered, 10 more states must be added—Alabama, Georgia, Iowa, Kansas, Mississippi, Oklahoma, South Carolina, South Dakota, Texas, and Washington. Of our farm land and buildings, as measured by value, 4 states show percentages above fifty. These are Illinois, Oklahoma, Mississippi, and South Dakota. When farm buildings are left out of account, the states of Delaware, Georgia, Iowa, Kansas, Nebraska, and South Carolina must be added to the list.

The number of states that had passed the half-way tenancy mark with respect to improved acreage was 5 in 1900, 8 in 1910, and 12 in 1920. The number that had passed the same mark with respect to land valuations was 2 in 1900, 5 in 1910, and 10 in 1920.

The highest percentage shown by any state on the basis of improved acreage in 1920 was Georgia with 59.8, and on the basis of land valuations, Illinois with 60.3.

It appears that lessee farming has become characteristic of vast areas not only in the cotton and corn belts but even in the Pacific Northwest. How vast these areas are may be understood by the

following comparisons. The tenants of the United States operate an area of unimproved land larger than the entire surface of France or Germany, and almost as large as Texas. They operate an improved acreage six times the area of Illinois, or Arkansas, or Iowa. The value of the farm property they operate exceeds the direct cost to the United States of the World War. If the Federal Farm Loan system is to be an important aid to tenants in financing the purchase of the land now rented, it is clear that it must operate in terms, not of millions, but of billions. If all instead of 5 per cent of the half billion made available to borrowers through the Federal Land banks and joint stock land banks in the last five years had been used to finance tenant purchases of farms, it would have met the first mortgage need on less than 5 per cent of the land now operated by tenants.

Decreases in the proportion of improved acreage operated under lease took place in 15 states between 1900 and 1920. These were found mainly east of the Appalachians and in the southeastern section. The states showing the most marked increases in the proportions of improved acreage rented were those of the northwest quarter of the United States.

When tenancy changes of the last two decades are put in terms of land valuations, it appears that the states of the Central West have also taken part in the movement toward increase. The renting of the more valuable lands, particularly within the corn belt, coupled with a somewhat increased operation by owners in the case of cheaper lands, appears to have been an important tendency in the Mississippi Valley regions.

In other words, the changes in the relative prominence of lessee agriculture in the United States have more marked significance when measured on the three bases, acreage, valuation, and number of farms, than when measured on the basis of number of farms alone. The relative amount of the changes indicated is not the least of the reasons for this. As against an increase of 7.9 per cent in the number of tenant farms per ten thousand for the two decades, there was an increase in the number of rented acres per thousand amounting to 20.9 per cent, and in the number of rented dollars worth of land and buildings per ten thousand amounting to 24.2 per cent. The rate of increase of tenancy is shown in percentages from twice to four times as large when expressed on the basis of acreage and valuation.

Comparing the two decades, 1900–10 with 1910–20, it appears that the number of tenant farms per ten thousand increased by 171 in the earlier period and by only 107 in the later period. Owing to the marked increase in acreage of unimproved land operated by lessees between

1910 and 1920, however, that decade showed a larger increase of leased acres per ten thousand than the preceding decade by nearly a third. In like manner, the number of dollars worth of land and buildings rented per ten thousand increased over twice as much in the decade just closing.

In the light of this analysis, the tide of tenancy is shown by the latest census to have continued its upward flow with little or no abatement.

REPORT ON AN ANTHROPOMETRIC INVESTIGATION OF THE POPULATION OF THE UNITED STATES

By Franz Boas, *Columbia University*

CHARACTERISTICS OF THE POPULATION OF THE UNITED STATES

The white population of the United States differs from that of Europe not so much in character as in the mode of assemblage of its component elements. The important theoretical and practical problems that arise in a study of the biological characteristics of our population relate largely to the effects of the recent rapid migrations of the diverse types of Europeans. The problem is further complicated by the presence of a large negro population, of small remnants of Indian aborigines, and by a slight influx of Asiatics.

It would be an error to assume that the intermingling of different European types is a unique historical phenomenon which has never occurred before. On the contrary, all European nationalities are highly complex in origin. Even those most secluded and receiving the least amount of foreign blood at the present time have in past times been under entirely different conditions. An excellent example of this kind is presented by Spain. The Iberians are the earliest substratum of population with which we are acquainted. The coast population was undoubtedly affected by a certain amount of intermixture with Phoenician and Greek colonists. There followed a number of migrations of Celtic tribes from northwestern Europe and a thorough colonization of the peninsula by Rome. The Teutonic tribes which invaded Spain came in part from the regions of the Black Sea. Later on we can trace waves of migration from northern Africa, which attained their greatest importance during the time of the Moorish empires. With the development of medieval conditions and the expulsion of the Moors and the Jews, the population of Spain became stable and there was no further disturbance due to important migrations. It is therefore evident that the present population of Spain contains elements derived from practically all parts of Europe and from northern Africa.

Similar conditions may be observed in Great Britain, where there is also clear evidence of a large number of waves of migration. In prehistoric times we find a long-headed type, quite different in appearance and in customs from a later round-headed type. With the beginning of historic times we observe first Roman colonization, then waves of

migration entering Great Britain from all parts of the North Sea, from Scandinavia and northern Germany, and, finally, the influx of the Normans. With this event extended migration ceased and the population of the island was gradually welded into the modern English.

Migrations of this kind may be recognized even in very early times. After sweeping over the older population of Greece, north European types established themselves in the Balkan Peninsula and on the Aegean islands during the so-called Doric migration, which occurred a thousand years before our era. Later on the movements of the Finnish ancestors of the Bulgarians and the migrations of the south Slavic peoples added to the intermixture of types in the eastern European peninsula.

It might seem that a few countries in Europe were not so much exposed to intermixture as those previously mentioned, and it is particularly assumed that Sweden and Norway represent a very homogeneous population. Still, we may recognize here also a considerable differentiation of local types. An investigation of the districts nearest to Finland shows very clearly an approach to the Finnish type which may be due to intermixture. In southern Norway is encountered a strongly aberrant type whose origin cannot be historically determined. In the northern area the Lapps present a foreign element. In later times immigrations were not by any means rare. Thus the development of the mining industry brought in a great many Walloons; and the nobility, at least, is a composite of descendants of natives from many parts of Europe. Historical evidence shows that the central parts of Europe over which migrations have swept periodically were, even more than the outlying districts, exposed to intermixture of different types.

Intermixture in Europe was largely confined to antiquity although in some parts it continued into the Middle Ages, whereas the intermingling of different local types in the United States is recent. Owing to the social conditions in ancient Europe amalgamation of distinct elements may have been rather slow. Notwithstanding the relatively small numbers of migrating individuals, it may have taken several generations for the intrusive and native populations to become merged. In the United States, owing to the absence of hereditary social classes, the amalgamation is on the whole more rapid and involves larger numbers of individuals than the intermixture which took place in earlier periods in the Old World.

The impression that the population of European countries is comparatively speaking "pure" in descent is founded on its stability. In northern and central Europe this condition developed after in-

dividual hereditary landholding was substituted for the earlier forms of agricultural life, and with the attachment of the serf to the soil which he inhabited. These conditions prevailed in the Mediterranean area even in antiquity, but in the northern parts of Europe they did not develop until the Middle Ages, when the more or less tribal organization of the people gave way to feudal states. During the period when the Celtic and Teutonic tribes moved readily from place to place a vast amount of mixture occurred in all parts of Europe. Later on, when families became settled, those parts of the populations which were proprietors of the soil, or otherwise attached to the soil, became stationary, and consequently intermixture between distant parts of the continent became very much less frequent than in previous times. On the other hand, the mutual permeation of neighboring communities probably became much more thorough.

These conditions of stability continued until by the development of cities diverse elements were brought together in the same community. This process became important with the growth of modern industrialism and with the concomitant growth of urban populations that were drawn together from large areas. Investigations made in different parts of Europe, particularly in Italy[1] and in Baden,[2] show differences in type between city populations and those of the open country. These may in part be explained by the strong intermixture of types drawn from a wide area which assemble and intermarry in the city. Observations of the population of Paris[3] indicate the same kind of intermixture of north European and central European types.

The settlement of the unoccupied districts of the United States has brought about an intermixture of types similar to that occurring in modern city populations, because settlers from different parts of Europe may dwell in close proximity in newly opened countries. Although in many cases we find a strong cohesion of farmers who come from the same European country, there is also a great deal of scattering.

It should, therefore, be understood that the problems presented by the population of the United States do not differ materially from the analogous European problems. The differences are due to the larger numbers of individuals involved in the whole process, in its rapidity, in its extension over rural communities, and in the forms of cohesion between members of the same group which are dependent upon the mode of settlement of the country. The process resembles earlier European mixtures in so far as many diverse European types are in-

[1] Ridolfo Livi, *Antropometria Militare*, p. 87 *et seq.*
[2] Otto Ammon, *Zur Anthropologie der Badener*, p. 641.
[3] Franz Boas, "The Cephalic Index," *American Anthropologist*, N. S. vol. 1, p. 453.

volved. In modern Europe only European types enter into the mixture, but a number of races morphologically removed from the white race enter into certain phases of the problem in America. Even this aspect of the problem was probably present in antiquity when slaves of foreign races formed a considerable part of the population.

The long continued stability of European populations which set in with the beginning of the Middle Ages and continued, at least in rural districts, until very recent times, has brought about a large amount of inbreeding in every limited district. In default of detailed statistical information in relation to the development of populations it is impossible to give exact data, but a cursory investigation shows that inbreeding of this type must have occurred for a very long time. The theoretical number of ancestors of every living individual proceeds by multiplication by two from generation to generation back, so that ten generations (or approximately 300 or 350 years) ago every single individual would have had 1,024 ancestors. Therefore, about 600 or 700 years ago there would be more than 1,000,000 ancestors for each individual. Considering the stability of population, such an increase in the number of ancestors is, of course, entirely impossible, and it necessarily follows that a very large number of individuals in the ancestral series must be identical, which means that there must have been a large amount of inbreeding.

The "loss of ancestors" becomes the greater the farther back we go in the ancestry and the more stable the population. It is obvious that particularly in the landholding group of families which remains from generation to generation in the same place, there must have been much inbreeding. Statistical information is available only for a few village communities and for the high nobility of Europe. The genealogies of all these families demonstrate that the decrease in the number of ancestors is very considerable. The calculations for the high nobility of Europe[1] show that in the sixth ancestral generation there are only 41 ancestors instead of 64; in the twelfth generation, only 533 instead of 4,094. These numbers seem to be quite similar to those found in the stable village communities of Europe. Owing to this intermixture and to the similarity of descent of the families constituting the population, each family represents fairly adequately the whole population, or as we might express it, the whole population is homogeneous, in so far as all the families have the same kind of descent. On the other hand, in a population that results from recent migration and in which individuals from the most diverse parts of the world come together, a

[1] Ottokar Lorenz, *Lehrbuch der gesamten wissenschaftlichen Genealogie*, Berlin, 1898, p. 289 *et seq.*, pp. 308, 310, 311.

single family will not be representative of the whole population, because entirely different ancestral lines will be present in the various families. Therefore the population will be heterogeneous in so far as the different families belong to different lines of descent. To illustrate this point we might assume a community consisting of whites and negroes in which the whites always intermarry among themselves, and the negroes among themselves. Obviously in such a population a single family would not be representative of the whole community, but only of its own fraction. On the other hand, if we had a community in which whites and negroes had intermarried for a long time, as is the case among the so-called Bastards of South Africa—a people very largely descended from Dutch and Hottentots and in which this intermingling has continued for a long time—we have a homogeneous population in so far as every family represents practically the same line of descent.[1] It will therefore be seen that homogeneity is not by any means identical with purity of race. In the case of a homogeneous population of mixed descent we may expect, on the whole, a high degree of variability in the family, while all the families will be more or less alike. On the other hand, in a heterogeneous population in which each part is comparatively speaking "pure," we may expect a low variability of each family with a high variability of the families constituting the whole population. On account of its migratory habits the American city population must be heterogeneous. Heterogeneous are also the immigrants and their immediate descendants, whereas in the stationary populations of New England villages and of the Kentucky mountains we have presumably homogeneous groups.

HEREDITY

In determining the characteristics of a population knowledge of the laws of heredity is indispensable. Ordinarily the term heredity in relation to racial characteristics is used in a somewhat loose manner, and we should distinguish clearly between the hereditary stability of a race and the hereditary characteristics which determine the bodily form and functions of an individual. The concept of hereditary stability in a race can mean only that the distribution of forms which occur in a population in one generation will be repeated in exactly the same way in the following generation. This is clearest in the case of a homogeneous population as defined before. In every population varying bodily forms of individuals will occur with characteristic frequencies. In an undisturbed homogeneous population we must

[1] Eugen Fischer, *Die Rehobother Bastards*, Jena, 1913. Franz Boas, "On the Variety of Lines of Descent Represented in a Population," *American Anthropologist*, N. S., Vol. 18, p. 1 *et seq.*

necessarily assume that each generation will show the same characteristic distribution of individual forms. If it did not do so there would be a disturbance of the hereditary stability.

Conditions are quite different in a heterogeneous population like that of the United States. Owing to intermarriages between the various constituent types there must be a tendency toward greater homogeneity, setting aside, of course, the influx of new immigrants. Experience shows that no matter how rigid may be the social objection to intermarriages between different groups, or how strong the pressure to bring about marriages between members of the same group, they will not prevent the gradual assimilation of the population. An instance of this kind is presented by the castes of India in Bengal. Notwithstanding the rigid endogamy of castes it has been observed that the highest castes are similar in type to the peoples of Western Asia, while the lower down in the scale of castes we go the more this type becomes mixed with the older substratum of the native population.[1] This can be explained only by intermarriage between the different castes which must have occurred notwithstanding the rigid laws forbidding it. The less the tendency toward segregation of different groups, the more rapid will be the approach toward homogeneity. Therefore notwithstanding the laws of hereditary stability in individual strains, there cannot be a hereditary stability of a heterogeneous population until homogeneity has been attained. It may even be considered doubtful whether a disturbance of the distribution of bodily forms may not occur as an effect of the intermingling of two populations similar or even identical in type, but of different ancestry, in which, therefore, a heterogeneity of ancestry exists.[2]

Thus it will be seen that the physiological laws of heredity are quite different from the statistical expression of the effects of heredity upon a large population. The latter depends upon both the biological laws of heredity and the peculiar social structure of the population which is being considered. These two aspects of heredity must be kept clearly apart.

Unfortunately, the laws of heredity in man are not clearly known, and it is not yet possible without overstepping the bounds of sound, critical, scientific method to apply them to the study of the characteristics of a population. A considerable amount of preliminary fundamental work must be done before we can proceed to the explanation of special complex phenomena. One fundamental point of view may be considered as established, namely, that when a definite couple

[1] H. H. Risley and E. A. Gait, *Census of India, 1901*, Calcutta, 1903, Vol. 1, p. 489 *et seq.*

[2] M. D. and Raymond Pearl, "On the Relation of Race Crossing to the Sex Ratio," *Biological Bulletin*, Vol. 15, 1908, p. 194 *et seq.*

of parents is given, the probability of occurrence of a given form among the descendants of this couple is fixed. In man it is not easy to demonstrate this fact because the number of children for each couple is small. If we assume, however, an organism in which each parental couple has an infinitely large number of offspring, the laws of heredity may be so expressed that each form that occurs among the offspring has a definite probability. In man these laws can be investigated only by combining many families in which both parents, or at least one of the parents, has the same characteristic form, although in this case the phenomenon is obscured by the fact that the same form in the parent does not necessarily mean the same ancestry.[1] Observation of various features of the body of man show that the simple forms of Mendelian heredity are not often applicable. It is true that in a number of cases of pathological modifications, the validity of the simple Mendelian formulas has been established. Even in these cases the number of observations is not sufficient to determine whether we are dealing with exact Mendelian ratios or with approximations. Practically all other cases are still open to doubt. Even in the case of eye color, which has been claimed to be subject to a simple Mendelian ratio with dominance of brown over blue, the available figures are not quite convincing.[2] For the more complex variable measurements of the body simple Mendelian ratios are certainly not applicable. Up to the present time the complex laws governing the frequencies of occurrence of bodily forms among descendants of an ancestral line are not known.

The investigation of any population must, therefore, take into consideration the detailed study of the laws of heredity.

THE INFLUENCE OF ENVIRONMENT

In settling in the United States the immigrants have been brought into a new environment, geographically as well as socially, and the question arises whether the new environment exerts an influence upon bodily form and functions. It has been customary to consider certain features of bodily development as absolutely stable, and anthropologists have characterized modern human types as "permanent forms" which have lasted without variation from the beginning of our modern geological period up to the present time. It is fairly easy to show that in this view exaggerated importance is ascribed to the phenomena of observed hereditary stability.

We know that the bulk of the body of an adult depends to a certain

[1] Boas, "On the Variety of Lines of Descent Represented in a Population," *loc. cit.*

[2] Helene M. Boas, "Inheritance of Eye Color in Man," *American Journal of Physical Anthropology*, Vol. 2, p. 15 *et seq.*

extent upon the more or less favorable conditions under which the child grows up. It has been shown that malnutrition or pathological conditions of various kinds may retard growth, and that the retardation may be so considerable that it cannot be made up by long continued growth. As a matter of fact, the bulk of the body at the time of birth is so small as compared to the bulk of body of the adult that it is easy to understand that environmental conditions must exert a considerable influence upon its development. Proof of this is the gradual increase of stature during the past fifty years, until 1914, which has been demonstrated by investigations in a number of countries in Europe, and the difference in stature which is found in the same nationality for people living under different economic conditions.[1]

Since many proportions of the body are related to stature and bulk, these will also undergo modifications due to environmental conditions. The influence of environmental conditions is not so obvious in those cases in which the bodily form is practically determined at the time of birth, or in those in which the total growth from the time of birth until the adult stage is very slight. It might be assumed that in all cases of this type heredity alone determines the characteristic form of the body.

From a wider point of view the assumption that environment has no influence upon the form of the body does not seem justified. It must be understood that the question of stability or instability of the body in relation to environmental influences has no relation to the question of the inheritance of acquired characteristics. Even if we should adhere most rigidly to the dogma of the impossibility of the transmission of acquired characteristics, we must admit that a modification of the bodily form of the individual is easily conceivable without the necessity of assuming any modification of the germ plasm owing to individually acquired variation. We should rather have to say that adaptability of a definite type is one of the hereditary characteristics of the germ plasm. The problem involved is readily understood in the case of plants which appear in strongly modified form according to the environment in which they grow. In many cases the amount of hairiness, the form of the leaves, etc., are subject to the degree of moisture of the soil, and an accurate description of the species would therefore involve a statement that the plant has a certain degree of hairiness, dependent as a definite function upon the moisture of the soil, or that the leaves have a certain form dependent upon outer circumstances. In other words, the plant has a definite form only under a definite environment, and with changing environment, the form changes.

[1] Rudolf Martin, *Lehrbuch der Anthropologie*, 1914, p. 225.

We may include under the group of environmental effects also all those variants of form and function that are dependent upon social habits which influence the organism. An influence upon bodily form is exerted by the habitual uses to which groups of muscles are put. Thus the rest position of the lower jaw is different in different areas. The English seem to hold the lower jaw a little farther forward than the Americans. The people of the western states relax the soft palate more than those of the North Atlantic area. The facial expression is determined by the development of the groups of facial muscles; the variations of certain aspects of the form of the hand and the foot are of this kind. The functioning of organs is even more markedly dependent upon habits, particularly upon habits firmly established during childhood. This is illustrated by the characteristic gait of individuals and of whole groups of people; by the involuntary movements in response to certain stimuli; by many of the expressive movements of the body; by habits of articulation; and by the dexterity and accuracy of movements obtained by early training.

Since we recognize the influence of environment upon the form of body including such features as bulk of body, or muscular forms and the functioning of organs, it seems justifiable to define racial characteristics as we do those of a variable plant, namely, by stating that under definite environmental conditions the bodily form of a race and its functioning are such as we observe, without prejudging the question in how far modifications in form and function may result from changing environment. The actual problem, then, would be to determine whether and how far the traits of the body may be so influenced. We should also bear in mind that it is perfectly conceivable that there may be congenital modifications in forms which are nevertheless not hereditary.[1] Constitutional changes in the body of the mother may bring about modifications in prenatal growth which to the superficial observer might give the impression of hereditary changes. These considerations demonstrate that it is necessary to consider this problem in any thorough investigation of the characteristics of the American population.

SELECTION

The question must be asked in how far selective agencies may determine the movements of the population, including immigration and emigration, the settlement of the western parts of the United States by the inhabitants of the eastern states, and the migration from country to city. Besides migration, the selective influences of mating, of mortality, and of fertility have to be taken into account. Of late years

[1] *Cf. infra* p. 198.

much stress has been laid upon the effect of selection upon the constitution of a population.

The effect of selection as determined by bodily form can be investigated to advantage only in a homogeneous population. When every family may be considered as representative of the whole population, and when all strata of society present the same physical characteristics, selective forces that are based on social stratification will not influence the selective results, because all social strata will be alike; and if it should be found that groups representing different bodily forms have different tendencies to migrate, or different rates of mortality or fertility, we might have an expression of the direct dependence of selection upon bodily form.

As a matter of fact, however, homogeneous populations do not exist anywhere in the world. A greater or less amount of heterogeneity has always been observed, and heterogeneity in our modern civilization, at least, is always connected with social stratification. In a heterogeneous population like that of the United States the difficulties in the way of determining a direct relation between selective influences and bodily form are almost insurmountable. If, for instance, descendants of a certain nationality are attracted to a particular area, as the Scandinavians to the northwest, the Hungarians to the mines of Pennsylvania, the Mexicans to the southern borderland of the United States, or the French Canadians to the New England states and northern New York, we must remember that each one of these social groups represents a certain physical type and that there will be, therefore, an apparent relation between selection and physical type which in reality is based on social factors.

Similar observations may be made with regard to selective mating. Since mating depends upon social contact, marriages will occur among the groups that associate together. Wherever nationalities cluster together, where denominational or racial considerations act as endogamic restrictions, there will be selective mating of similar types due to social heterogeneity. Besides this there may be a certain amount of selection that unites tall with tall or expresses the sexual attractiveness of other bodily features.

Social heterogeneity exerts an influence also upon the mortality and the fertility of different groups. The more recent immigrants are on the whole less well-to-do than the earlier immigrants and their descendants. We know that there is a relation between fertility and economic well-being and we find, therefore, that the number of children of the more recent immigrants is greater than that of the descendants of earlier immigrants, so that, setting aside the question of mortality, there

would be a shifting in the distribution of the population in favor of later immigrants. Since the earlier immigrants represent the northwestern European type and the later immigrants the south and east European types, there will appear in this case also a selection according to bodily form, which is due not to the direct relation between physical characteristics and fertility, but rather to the fact that the one economic group is composed of one type, and the other economic group of another type. In many cases the relation between descent and social stratification is so complex that it easily escapes our notice, and for this reason we may observe phenomena of selection apparently related to bodily form but actually due to obscure social causes that are discovered with great difficulty only.

On the other hand it cannot be denied that in some cases at least there must be a direct relation between bodily form and physiological function on the one side and selective processes on the other. It is, for instance, quite obvious that in the settlement of the new western countries a certain bodily and mental vigor was necessary to enable a person to undertake the venture. It has often been pointed out, although it has never been proven empirically, that in this way there must have been a selection from the inhabitants of the New England villages who migrated westward and that the emigrants represented a physically superior type. Even though this conclusion is not based on observation it seems highly probable. To the same group of phenomena would belong the supposed greater susceptibility to certain forms of disease of slightly pigmented individuals, as compared with the greater power of resistance of brunette individuals. I am not by any means convinced that incontrovertible proof of this assumption has been given; but if it were true that the constitution of the blond is weakened by exposure to intense sunlight, there might be a selective influence of this kind when a people move from the cloudy temperate zones to the brilliant sunlight of more southern and more arid climes.

In considering the selective influences of environment it should be borne in mind that the human body is so constituted that all its organs can operate adequately under widely varying circumstances. Our lungs are able to supply the needs of our body under the air pressure that prevails at the level of the sea, and they operate adequately at an elevation of 20,000 feet where the air is highly rarefied. The heart can adjust itself to the variation in demands made upon it, either in sedentary life at the level of the sea, or in active life in high altitudes. Our digestive organs may adapt themselves to a purely vegetable diet or again to a purely meat diet. Our central nervous system is also capable of adjusting itself to the most varied conditions of life. As

long, therefore, as the conditions of environment do not exceed very elastic limits, it is not probable that selective influences would become operative to any very great extent, at least not in so far as they are determined solely by the form and functioning of the organs of the body.

RACIAL AND INDIVIDUAL DIFFERENCES

An investigation of the bodily forms of the individuals constituting a race, homogeneous or heterogeneous, shows that they differ considerably among themselves, in every single feature, such as pigmentation, form of hair, size and proportions of the body, physiological reactions. These differences are measurable and express the degree of variability of the race. A complete presentation of the characteristics of a race would contain a statement of the relative frequency of each particular bodily form which occurs among the individuals constituting the race. When comparing, from the point of view of anatomical or physiological characteristics, the racial types of Europe which constitute the bulk of the American population, it appears that the range of variation for the different types is of such a character that a great many individuals belonging to one type correspond to other individuals belonging to another type. In other words, there are certain forms common to all populations of Europe. To give an example: We find strongly contrasting head forms in northern Italy and in Sardinia. Nevertheless an investigation of the distribution of head forms in each one of these districts shows that 27 per cent of the population may belong either to Sardinia or to northern Italy. In other words, there is a very considerable amount of overlapping of bodily form between neighboring types, and it is only when we consider races that are fundamentally different that we find certain characteristics that do not overlap. Comparing, for instance, the blond north European white and the dark Sudanese negro, there is no overlapping with regard to pigmentation, form of hair, form of nose, form of lips, etc. If, on the other hand, we proceed by steps from northern Europe to the Sudan, a great many intermediate and overlapping steps between these extreme forms will be found, so that only the extremes would really be entirely separate. While it may be that two races are quite distinct with regard to certain features, there are always other features with regard to which the differences are so slight that the assignment of any one individual to either one race or the other would be beset with doubt.

It has been customary to express the differences between racial types by the difference between the averages of each type or between the modes (the most frequent values) that are characteristic for each type.

It is easily shown that such a description is misleading. If we wish to express the difference between two individuals, each of whom has constant characteristics, we may proceed in this manner. If one individual measures 170 cm. and another 165 cm., the difference between them is 5 cm. If, however, a certain population has an average stature of 170 cm., and another population an average stature of 165 cm., we cannot say that the difference between the two is 5 cm., because if there is a wide range of variability there will be a large number of individuals among the taller population who have exactly the same statures as individuals of the shorter population. To give arbitrarily selected figures, the one may range perhaps from 150 to 190 cm., the other from 145 to 185 cm. In this case an individual that measures anywhere between 150 and 185 cm. might belong to either class. It must, therefore, be clear that if we speak of differences between two races we do not necessarily mean differences between individuals, and these two concepts must be kept clearly apart. The bulk of our modern literature concerning racial differences is open to misinterpretation owing to a lack of a clear understanding of the significance of the term "difference" as applied on the one hand to individuals and on the other hand to races. The generalization, which is often made (to use our previous instance), that the one population is 5 cm. shorter than the other is often interpreted as meaning that this implies a characteristic of all the individuals of a race, while actually a single selected individual of the shorter race may be much taller than a single selected individual of the taller race. This is equally true of all those anatomical, physiological, and psychological characteristics which exhibit overlapping of individuals. It is also true of those that show no overlapping, because the difference between two selected representative individuals may vary within wide limits. If it is stated that the whites have a larger brain than the negroes, this does not mean that every white person has a larger brain than any negro, but merely that the average of the negro brains is lower than the average of the brains of the whites. With regard to many characteristics of this kind, we find that the difference between the averages of different races is insignificant as compared to the range of variability that occurs within each race.

An additional point should be considered in connection with this phenomenon. Most of the anatomical characteristics of the body are stable throughout adult life, until senile degeneration begins. On the other hand, physiological and psychological functions are not the same in the same individual at all times. They vary strongly with environmental conditions and particularly with different demands made upon

the organism. The variability of physiological and psychological responses is therefore much greater than the variability of anatomical form, because the two former combine the variability due to the difference in the functioning in various individuals with the variations of response under varying conditions. When comparing racial types we must therefore avoid expressing a difference of types simply as a difference of averages.

Another point must be considered which may be illustrated by an example. Let us assume that in one area the color of the hair varies from black to dark brown with an average value on a certain definite shade, and that in another population the color of the hair varies from dark blond to very light blond with an average on a certain shade of blond. In this case the two distributions will not overlap at all. On the other hand, let us assume that we have two populations with the same average shades of brown and of blond as before, but in the one a variation which begins with black and extends into blond shades, and in the other a pigmentation which begins with a very dark brown and extends into very light blond, so that the two overlap. Obviously the two differences will not impress us as the same, notwithstanding the fact that the two averages remain the same. It is therefore indispensable that in an investigation of this kind the significance of the difference between two populations should be clearly expressed, and that the impression should be avoided that the difference between racial types is identical with the difference between individuals.

Still another point deserves attention. Many writers assume that an individual of a certain type represents the same biological type regardless of the racial group to which he belongs. To give an example: a round-headed person of the Tyrols is equated with a round-headed person of southern Italy, at least in so far as the form of the head is concerned. Even if we assume that the round-headedness of the two individuals is of the same kind, this inference is not tenable. It is true that by chance the two individuals may belong to the same lines of descent, but a study of a series of homologous individuals shows that physiologically they are not the same, notwithstanding the sameness of the particular trait that is made the subject of study. When we select, for instance, individuals with the same head-index of 82 in a population that has the average head-index of 85, the children of the selected group will be found to have an average head-index of 84; when we select individuals with the same head-index of 82 in a population that has the average head-index of about 79, the children of the selected group will be found to have an average head-index of about 80, for the reason that there will be in each case reversions to the average

type of the population to which the selected group belongs. In other words, the individuals which are selected from any population must always be considered as part of this population and cannot be studied as though they were an independent group.

EUGENICS

One of the reasons for the special stress that is laid upon race investigations is the fear of race degeneration. It is assumed that the intermixture between different racial types and the rapid increase of the poorest part of the population have a deteriorating effect upon the nation. In the introductory remarks I have tried to show that there is little reason to believe that racial intermixture of the kind occurring in the United States at the present time should have a deteriorating effect. I do not believe that it has been adequately proved that there is a clearly marked tendency toward general degeneration among all civilized nations. In modern society the conditions of life have become more varied than those of former periods. While some groups live under most favorable conditions that require active use of body and mind, others live in abject poverty and their activities have more than ever before been degraded to those of machines. At the same time the variety of human activities is much greater than it used to be. It is therefore quite intelligible that the functional activities of each nation must show an increased degree of differentiation, a higher degree of variability. Even if the general average of the mental and physical types should remain the same, there must be a larger number now than formerly who fall below a certain given low standard, and also a larger number who exceed a given high standard. The number of defectives can be counted by statistics of poor relief, delinquency, and insanity, but there is no way of determining the increase of those individuals who are raised above the norm of a higher standard, and they escape our notice. It may therefore very well be that the number of defectives increases without influencing the value of a population as a whole, because it is merely an expression of an increased degree of variability.

Furthermore, arbitrarily selected absolute standards of value do not retain their significance. Even if no change in the absolute standard should be made, the degree of physical and mental energy required to keep oneself under modern conditions above a certain minimum of achievement is greater than it used to be. This is due to the greater complexity of our life and to the increasing number of competing individuals. Greater capacity is required to attain a high degree of prominence than was needed in other periods of our history. The

claim that we have to contend against national degeneracy must, therefore, be better substantiated than it is now.

The problem is further complicated by the advance in public hygiene which has resulted in lowering infant mortality and has thus brought about a change in the composition of the population, in so far as many who would have succumbed to deleterious conditions in early years enter into the adult population and must have an influence upon the general distribution of vitality.

Notwithstanding the doubtful basis of many of the assertions relating to degeneracy, the problem of eugenics is clearly before the public, and the investigation of racial and social types cannot be separated from the practical aims involved in the eugenic movement.

The fundamental thought underlying eugenic theory is that no environmental influences can modify those characteristics which are determined by hereditary nature. *Nurture*, it is said, cannot overcome *nature*.

We should recall here what has been said before regarding the difference between the characteristics of hereditary strains and those of races, and that while it is true that strains differ greatly in physical and mental vigor and in specific characteristics, it is not equally true of races as a whole, because strains which are very much alike in all these characteristics are found in every single race. Even if it is not possible to prove with absolute certainty the complete identity in mental traits of selected strains belonging to races as diverse as Europeans and negroes, there is not the slightest doubt that such identity prevails among the various European types. Eugenics, therefore, cannot have any possible meaning with regard to whole races. It can have a meaning only with regard to strains. If the task of the eugenist were the selection of that third of humanity representing the best strains, he would find his material among all European and Asiatic types, and very probably among all races of man; and all would contribute to the less valuable two thirds.

As an objection to this point of view it is sometimes claimed that closely allied animal types are so different in their physical make-up and mental characteristics that members of one race can be clearly differentiated from those of another race. It is, for instance, said that the race-horse and the heavy dray-horse are so different in character that no matter what may be done to the dray-horse its descendants can never be transformed into race-horses. This is undoubtedly true, but the parallelism between the races of dray-horses and race-horses on the one hand and human races on the other is incorrect. The races of horses are developed by careful selection, by means of which physical

and mental characteristics are fixed in each separate strain, while in human races no such selection occurs. We have rather a racial panmixture, which brings it about that the racial characteristics are distributed irregularly among all the different families. As a matter of fact, dray-horses and race-horses correspond to family strains, not to human races, and the comparison is valid only in so far as race-horses and dray-horses are compared to the characteristics of certain family lines, not to human races as a whole. In Johannsen's terminology the human races are to a much greater extent phenotypes than races of domesticated animals.

For this reason the task of eugenics cannot be to devise means to suppress some races and to favor the development of others. It must rather be directed to the discovery of methods which favor the development of the desirable strains in every race.

This problem can be attacked only after the solution of two questions. First of all, we have to decide what are the desirable characteristics; and secondly, we must determine what characteristics are hereditary. With regard to the former question, we shall all agree that physical health is one of the fundamental qualities to be desired; but there will always be fundamental disagreement as to what mental qualities are considered desirable—whether an intense intellectualism and a repression of emotionalism or a healthy development of emotional life is preferable. Obviously, it is quite impossible to lay down a standard that will fit every person, every place, and every time, and for this reason the application of eugenic measures should be restricted to the development of physical and mental health. Even if it were possible to control human mating in such a way that strains with certain mental characteristics could be developed, it would seem entirely unjustifiable for our generation to impose upon future times ideals that some of us may consider desirable. It might furthermore be questioned whether the interests of humanity will be better served by eliminating all abnormal strains which, as history shows, have produced a number of great men who have contributed to the best that mankind has done, or by carrying the burden of the unfit for the sake of the few valuable individuals that may spring from them. These, of course, are not scientific questions, but social and ethical problems.

For the practical development of eugenics it is indispensable to determine what is hereditary and what is not. The ordinary method of determining heredity is to investigate the recurrence of the same phenomenon among a number of successive generations. If, for instance, it can be shown that color-blindness occurs in successive generations, or that certain malformations like polydactylism are found repeatedly

in the same family, or that multiple births are characteristic of certain strains, we conclude that these are due to hereditary causes; and if parents and children have the same head form or the same or similar statures, we decide that these similarities also are due to heredity. It must be recognized that in many of these cases alternative explanations are conceivable. If, for instance, a family lives under certain economic conditions which are repeated among parents and children, and if these economic conditions have a direct influence upon the size of the body, the similarity of stature of parents and children would be due to environment and not to heredity. If a disease is endemic in a certain locality and occurs among parents and children, this is not due to heredity but to the locality which they inhabit. In other words, wherever the environmental conditions have a marked influence upon bodily characteristics, and wherever these environmental conditions continue for a number of generations, they have an effect that is apparently identical with that of heredity. In many cases the causes are so obvious that it is easy to exclude persistence of characteristics due to environment. Under other conditions the determination of the causes is not so easy.

It is still more difficult to differentiate between heredity and congenital features. For example, if a child before birth should be infected by its mother, there might be the impression of a hereditary disease, which, however, is actually only congenital in the sense that it is not inherent in the structure of the germ plasm. Although the distinction between environmental causes as previously defined and hereditary causes is generally fairly easy, the distinction between congenital causes and true hereditary causes is exceedingly difficult, in many cases impossible. The long continued discussions relating to hereditary transmission of disease are a case in point. Most of these questions cannot be solved by statistical inquiries, but require the most careful biological investigation. The conditions, however, are such that we must demand in every case a clearer differentiation between these three causes.

There is little doubt that in the modern eugenic movement the assumption of hereditary transmission as a cause of defects has been exaggerated. Although certain mental defects that occur among well-to-do families seem to be determined by heredity, the mental defects generally included in eugenic studies are of such a character that many of them may readily be recognized as due to social conditions rather than as expressing specific hereditary traits. A weakling who is economically well situated is protected from many of the dangers that beset an individual of similar characteristics whose economic condition

is not so favorable, and it must be admitted that criminality in families that may be mentally weak and which are at the same time struggling for the barest subsistence is at least as much determined by social conditions as by heredity. Investigators of criminal families have succeeded in showing frequencies of occurrence of criminality which are analogous to frequencies which may be due to heredity, but they have failed to show that these frequencies may not as well be explained either wholly or in part by environmental conditions. We should be willing to admit that among the poor undernourished population, which is at the same time badly housed and suffers from other unfavorable conditions of life, congenital weakness may develop which lowers the resistance of the individual against all forms of delinquency. Whether this weakness is hereditary or congenital is, however, an entirely different question. Experiments made with generations of underfed rats[1] suggest that a strain of rats which has deteriorated by underfeeding can be fed up by a careful amelioration of conditions of life, and it may well be questioned whether delinquent strains in man may not be improved in a similar way. Certainly the history of the criminals deported to Australia and of their descendants is very much in favor of such a theory. In other words, it seems very likely that the condition of our subnormal population is not by any means solely determined by heredity, but that careful investigations are required to discriminate between environmental, congenital, and hereditary causes.

FORMULATION OF PROBLEM

From the preceding discussion, we may formulate the principal problems that must be taken up in a study of the population of the United States. We have to investigate first the degree of homogeneity of the population; second, the hereditary characteristics of the existing lines; third, the influence of environment; fourth, the influences of selection. On the basis of the data thus collected, we have to interpret the significance of the differences between various types, and investigate the bearing that our results may have upon public policies.

The study of the adult population alone would not give us adequate data to enable us to clear up the causes which determine the final development of the body—the events which take place during the period of growth must also be taken into consideration.

Familiarity with the bodily forms of children is necessary also from a morphological point of view. On the whole, the development of individuals is divergent, so that the most characteristic forms of each type are found in the adult male. The adult female forms are not quite so divergent, perhaps in part for the reason that the period of development of the female is shorter than that of the male, although it must be remembered that secondary sexual characteristics are present in childhood. The younger the human form that we investigate, the less clearly are racial characteristics expressed. We may, therefore, say that the most generalized forms of a racial type

[1] Helen Dean King, *Studies on Inbreeding*, Wistar Institute, 1919.

will be found in the infant or, even still more clearly, in prenatal stages, while the most highly specialized local forms will be found in the male adult. A knowledge of the specialized forms ought to include, therefore, a study of progressive differentiation. Particularly for the study of the influences of environment it is indispensable that the development of the body in childhood should be studied while the influences are still at work. We have to know the conditions which bring about retardation or acceleration in the development of various parts of the body, and their ultimate effects upon the human form. We must study other minute changes that may perhaps not be related to retardation or acceleration, but that may be due to a direct effect of environmental causes. In the adult these changes have been completed and can no longer be subjected to analysis, while in the growing child, their gradual development and unfolding may be observed.

The same is true with regard to selection. If selection is related to bodily form, it will probably act with particular intensity during the early years of childhood. It might be revealed by a comparison of the surviving and dying parts of the population of various ages.

These considerations make it quite necessary to include in the study of the population, not only adults, but also children.

One method of approach should consist, therefore, in the study of the growth and development of children, classified according to descent and geographical and social environment. If it were feasible to include records of the longevity of the individuals measured in childhood, the problem of selection could also be attacked. In the study of adults a careful classification according to descent and social position will be necessary.

The phenomena of homogeneity and of heredity make it necessary that the investigation should not be confined to studies of individuals, but that the anatomical characteristics of families should be made the subject of inquiry.

A considerable amount of work has been done by many investigators, throwing light upon a number of aspects of the problems here discussed. The earliest and most extensive series of observations was collected in connection with the War of the Rebellion and was published by Gould and Baxter.[1] Their well-known statistics, which have been quoted again and again, give data with regard to the stature of enlisted men according to their nativity, descent, and occupation, and reveal the facts that inhabitants of different parts of the United States differ in their physical development; that the differences between the various European nationalities are repeated here; but that in every single case, the members of a certain nationality exceed in bulk of body the corresponding European series; and, finally, that certain differences may be observed between groups of individuals following different occupations.

The next important inquiry relating to our subject was an investigation of school children of Boston by Henry P. Bowditch,[2] in which similar differences appeared. Bowditch also showed that the differences between various nationalities persisted throughout the period of growth, and that marked differences are found according to social stratification. Classification of the population according to the occupation of the parents showed a better development among the commercial and professional classes than is found among unskilled labor. Soon after Bowditch's investigation

[1] B. A. Gould, *Investigations in the Military and Anthropological Statistics of American Soldiers*, New York, 1869.

[2] H. P. Bowditch, "The Growth of Children," Eighth Annual Report, Massachusetts Board of Health. Boston, 1875, pp. 273–323; Tenth Annual Report, 1879, pp. 33–62; 21st Annual Report, 1890, pp. 287–304; 22nd Annual Report, 1891, pp. 479–525.

similar inquiries were instituted by Peckham[1] in Milwaukee, and later on in a number of other cities—Worcester, Mass.;[2] St. Louis, Mo.;[3] Toronto, Canada;[4] Oakland, Cal.,[5] etc. On the whole, the methods pursued were similar to those applied by Bowditch, and the results proved the occurrence of analogous phenomena. Porter, in his investigation in St. Louis, added to his inquiries the problem of the relative development of the children of varying mental achievement, and demonstrated a difference in the development of what he called precocious and dull children. Work of this type was gradually taken up by educational institutions and the effort was made to correlate physical development with school work, with a view to demonstrating a practical way of assigning a child to his proper developmental stage.

In similar investigations in Europe attention had been called to the fact that the measurement of children of different ages and the calculation of a growth curve on this basis does not give us adequate information with regard to the details of the phenomena of growth, and it was pointed out that repeated measurements of the same individual are necessary to obtain fuller records. In spite of numerous efforts that have been made to obtain such series, it has not been possible up to the present time to follow out the development of the same individual from childhood to adult life, at least not in numbers that are sufficient for a clear understanding of the phenomena involved in this process.

A certain amount of material bearing upon stature and weight has been collected by life insurance companies. This, however, is probably to a great extent so uncertain that it is of slight use only for scientific investigations. Military statistics taken in the United States since the War of the Rebellion are not numerous and not very extensive. A certain amount of work was done during the recent war, but the results have only now been made accessible. The only fairly extended investigation of families that has been undertaken in the United States was made in connection with the work of the Immigration Commission, during which a fairly large number of Jewish, Bohemian, Italian, and Slavic families were studied in such a manner that the phenomena of heredity could be considered in some detail.

We have practically no material whatever bearing upon the facts of racial mixture. It is particularly worth remembering that there are hardly any investigations to speak of that bear upon the physiological development of the negro and mulatto population. In view of the ever-repeated claim that the mulatto is inferior in physical development to either the pure negro or to the white, and considering the large number of mulattoes in our population, it seems of fundamental importance that an investigation of this kind should be made.

Although less important from a practical point of view than the negro problem, race mixture between whites and Indians has received some attention. Material collected in 1892 shows that the half-blood, so far as fertility and stature are concerned, is superior to the full-blood Indian.[6] The observations relating to fertility

[1] C. W. Peckham, "The Growth of Children," Report of Wisconsin Board of Health, 1881, pp. 28–73.

[2] Franz Boas and Clark Wissler, "Statistics of Growth," Report U. S. Commission of Education, 1904, pp. 25–132.

[3] W. T. Porter in the Transactions of the Academy of Sciences of St. Louis, "The Physical Basis of Precocity and Dullness," 1893, pp. 161–81; "The Relation between the Growth of Children and their Deviation from the Physical Type of their Sex and Age," 1893, pp. 263–80; "The Growth of St. Louis Children," 1894, pp. 263–380; also Quar. Pub. of Amer. Stat. Ass'n, NS 3, pp. 577–87, 4, 28–34.

[4] Franz Boas, "The Growth of Toronto Children," Report U. S. Commission of Education for 1896–97, pp. 1541–99.

[5] Franz Boas, "The Growth of Firstborn Children," *Science* NS I, pp. 402–404.

[6] Franz Boas, "The Half-Blood Indian, an Anthropometric Study," *Popular Science Monthly*, Vol. 45, 1894, pp. 761–70.

Louis R. Sullivan, "Anthropometry of the Siouan Tribes," Anthropological Papers of the American Museum of Natural History, Vol. 23, Part III, p. 199.

were confirmed by the material collected in the census of 1910.[1] Recently an inquiry into the characteristics of the half-bloods of Minnesota was made by Professor Albert E. Jenks.[2] We are still lacking, however, full investigations into the anatomical and physiological characteristics of half-bloods.

The problem of the intermixture between negro and white and negro and Indian has hardly been touched at all. A few studies of negro children and soldiers do not contribute much to our knowledge. A systematic study of the problem was made by Felix von Luschan in 1915, but the results of his observations are not yet available. Another important inquiry is that by Eugen Fischer on the Rehobother Bastards, the descendants mainly of Dutch settlers and Hottentots in South Africa. This is the only work in which the anthropological characteristics of the mulattoes have been taken up in detail. The theoretical as well as the practical importance of the investigation of the mulatto question can hardly be sufficiently emphasized. On the one hand, we may hope to obtain by this means an insight into the laws of heredity in man. On the other hand, the well-being of so many millions of citizens of our country is involved that the most painstaking inquiry should be demanded. This is the more urgent since many states have regulated race intermixture by laws which are based simply upon public prejudice without the shadow of knowledge of the underlying biological facts—without even the knowledge of the peculiar form of racial intermixture that characterizes the relations between whites and negroes in the United States. In by far the greater number of cases the mother is a negress and the father a white man. This results in an infusion of white blood into the negro race without affecting materially the white race. A searching analysis of the hereditary characteristics of the racial groups has not yet been made. It is true that the records of morbidity suggest typical physiological differences, but considering the fact that similar differences are found between different social groups of the same race, it is not possible without further investigation to distinguish definitely between the influences of heredity and of social environment.[3]

I refrain from giving a detailed bibliography and review of the anthropometric material collected in the United States in view of the very excellent collection of titles made by Professor Bird T. Baldwin, of the Bureau of Child Study of the University of Iowa.[4]

PROPOSED INVESTIGATIONS

The first and most fundamental inquiry that has to be made relates to a description of the various types constituting the population of the United States. As explained before, it will not be sufficient to describe the adult male and female forms, but it will also be necessary to determine the course of growth and development which is characteristic of each form. In order to carry through this inquiry it is necessary to obtain information with regard to the forms characteristic of each moment of the period of the development, and to determine the sequence of the characteristic developmental stages of each type. It is not admissible to assume that the physiological conditions which are found in a six-year-old Italian child must be the same as those of a six-year-old Scandinavian child. Furthermore, the individuals of each racial group will differ among themselves considerably with regard to the time

[1] Roland B. Dixon, *Indian Population in the United States and Alaska*, 1910; Washington, 1915, pp. 157–60.

[2] *Indian-White Amalgamation*, University of Minnesota Studies in Social Science, No. 6, Minneapolis, 1916.

[3] See also E. B. Reuter, *The Mulatto in the United States*, Boston, 1918.

[4] *The Physical Growth of Children from Birth to Maturity*. Iowa Child Welfare Research Station Study, Vol. I, No. 1.

when certain stages of physical development are reached, and it is therefore necessary to investigate fully the variability of physiological development characteristic of each group. A little work of this kind has been done. Pryor's and Roach's investigations of ossification, a number of inquiries into the eruption of teeth, Crampton's investigations on the approach of puberty, all relate to this subject. The material collected is, however, entirely inadequate and does not give a clear insight into the conditions that determine the variation in time when certain phenomena set in. The following table shows the rough values which are available at the present time, indicating the period when certain characteristic features develop, and the variability of occurrence of this period.

Age in years	Observation	Variability in years
0.0	Pregnancy	±0.04
0.6	Eruption of first incisors	±0.21
1.6	" " first molars	±0.31
4.2	Ossification of scaphoid bone, girls	±1.4
4.2	Ossification of trapezoid bone, girls	±1.2
5.8	Ossification of scaphoid bone, boys	±1.1
6.2	Ossification of trapezoid bone, boys	±1.3
7.0	Eruption of inner permanent incisors, girls	±1.6
7.5	" " inner permanent incisors, boys	±1.4
8.9	" " outer permanent incisors, girls	±2.1
9.0	" " bicuspids, girls	±2.8
9.5	" " outer permanent incisors, boys	±2.1
9.8	" " bicuspids, boys	±1.6
11.2	" " permanent canines, boys	±1.4
11.3	" " permanent canines, girls	±1.0
12.7	Beginning of pubescence, boys	±1.6
12.8	Eruption of second molars, girls	±1.6
13.2	" " second molars, boys	±2.0
14.6	Completed pubescence, boys	±1.1
14.9	Puberty, girls	±2.0
19.3	Eruption of wisdom teeth, boys	±2.1
22.0	Eruption of wisdom teeth, girls	±1.8
35.0	Preauricular wrinkles	±6.6
36.5	Hair on tragus	±8.3
44.5	Menopause	±5.3
62.5	Death due to arterial diseases, men	±13.2

Any attempt to subdivide this series according to nationality or environmental conditions would be premature, except for the period of adolescence for which more extensive statistics are available. It must be considered one of the most urgent aims of an investigation to determine the sequence of events and the racial and environmental conditions that influence them. There are indications that these problems may be found to be exceedingly intricate. Thus we have evidence to show that the development of poor children is considerably retarded. Nevertheless, it seems that the second dentition among these children is accelerated. This may perhaps be due to less care given to the deciduous teeth and their earlier loss which stimulates the appearance of the permanent teeth—or it may be due to other causes. It is, however, an indication that the sequence of events indicating the physiological changes in the body are subject to quite diverse causes.

The determination of all phenomena of this kind is very difficult when the attempt is made to derive data by the so-called generalizing method, that is to say, if we merely collect information that children of a certain age show the stage of development in question so and so often, and if we try to derive the rate of development by subtract-

ing the relative frequency of occurrence observed in one year from the relative frequency of occurrence in the next year. If we observe, for instance, that a certain tooth is present in 50 per cent of the children of one age and in 70 per cent of another set of children who are one year older, and conclude that in 20 per cent of the children the tooth in question will erupt in the course of that year, the different composition of the annual groups and the different numbers observed make it difficult to obtain reliable results. It is almost indispensable that for each individual there should be noted the moment of occurrence of the physiological change which is being studied. Material of this type is almost non-existent.

The movability of our modern city populations causes great practical difficulty in the organization of this work. It is not easy for an investigator to remain in touch for a sufficiently long time with the same children, and so many children change from one place to another that an initial number of, let us say one hundred, who are studied when five years old, will have dwindled down to an insignificant number at the time when the adult stage is reached. For this reason an elaborate organization is needed to carry through this work completely. To a greater or less extent, the work must be pieced together of fragments. For children of school age, roughly speaking from four or five years to fourteen years, the investigation might be organized. For older children of high-school age, it will also ordinarily be possible to carry through the inquiry, and in certain cases the transfer of a subject from high school to college may also be followed up. It is, however, obvious that the individuals who can be followed in this way are a group selected according to economic and social conditions. Those groups of the population which are well-to-do and who lay great stress upon the acquisition of a good education will be represented much more fully than other groups. The observations for different ages will therefore require a consideration of the different composition of the series. An organization like the Child Study Bureau of Chicago or the corresponding organizations in Iowa City and Detroit, or the Association for the Improvement of the Conditions of the Poor in New York, will be best able to control inquiries into these subjects.

The most difficult problem encountered in these investigations is the differentiation between hereditary differences and those due to retardation or acceleration. To give an example: A boy twelve years old may be tall because his hereditary characteristics are such that he belongs to a tall stock, or it may be that he is tall on account of an acceleration of his development. Since, furthermore, the adult stature of the individual will depend not only upon his hereditary characteristics, but also upon environmental conditions that have an effect upon the acceleration or retardation of his growth, it is difficult to determine directly how much is contributed by hereditary and how much by environmental causes. From a practical point of view the demand is always made that the anthropometric investigation of the individual shall differentiate between these two causes.

In most cases, however, it seems almost impossible to do so, except by a very detailed investigation of the physiological conditions of the body. Measurements are always subject to alternative explanations, as being due either to hereditary causes or to acceleration or retardation, while physiological changes are not so likely to be fundamentally different for different hereditary lines. If, for instance, in a certain individual the loss of healthy deciduous canines should be very much retarded, we should have the right to assume that, in whole or in part, his bodily development may be influenced by retardation. This, of course, presupposes a previous investigation which would show that the hereditary characteristics of different strains do not show very great differences in the time element of the loss of the first canine, provided the environmental conditions remain the same. Here, again, we are

entirely lacking in material that would enable us to answer this question, and it is evident that a very considerable amount of information would have to be amassed in order to enable us to solve the problem. It does not seem a hopeless task to determine the contributory effect of retardation and acceleration in an individual child, but it presupposes a much more thorough knowledge of the sequence of the developmental stages than we now possess.

The description of racial types cannot be considered complete without an inquiry into the homogeneity or the heterogeneity of the series. It is clear from the remarks made on page 185 that this problem can be solved only by an investigation of the forms represented in fraternities, because homogeneity can be proved only by showing that the types represented in different families are the same. In other words, the investigation of homogeneity must be based on an inquiry into the variations presented by different families. The small size of the human family makes it necessary to see to it that the proper weight is given to each fraternity in accordance with its numerical composition.[1] This investigation must be supplemented by an inquiry into each fraternity, the variability of which will depend upon the more or less composite character of its ancestry.

We are thus led to a consideration of the problem in how far it is possible to discover relative unity or multiplicity in the ancestry of a racial type. The method to be pursued will depend entirely upon the laws of heredity involved. In those cases in which we have some kind of Mendelian inheritance—that is to say, a tendency of the offspring to revert to either parental type—we must obviously expect a higher degree of variability in the mixed types than the one found in the pure parental types. Attention has been called to the occurrence of such a phenomenon with regard to the head index of Italians.[2] The short-headed north Italians are, comparatively speaking, uniform in type, and the long-headed south Italians are also fairly uniform in type, while in the intermediate regions in which undoubtedly the two types have intermingled for a long period, the variability of the head-index is very much increased. In a similar way, we find that there is an increase of variability in Sweden in those regions in which there is an admixture of foreign types that are more short-headed than the Swedes.[3] It has also been shown that in those cases in which father and mother belong to the same racial group, but in which they represent extreme head forms, the one extremely short-headed, the other extremely long-headed, the variability of the children is greater than in those cases in which the parents represent nearly the same type.[4] We recognize, therefore, that when a Mendelian reversion occurs, increased variability may indicate composite descent.

There are, however, other cases in which the results of mixture have not the effect of increasing variability. Statistics of half-blood Indians have shown that the width of face, which is very great in the Indian race and very small in the white race, has an intermediate value among the half-bloods, with a marked tendency, however, of reversion to a form that is narrower than the face of the pure Indian and wider than the face of the pure white, while the values for width of face which are half-way between the characteristic values of the Indians and of the whites are not so frequent as the two other values previously mentioned. There is, therefore, a certain kind of reversion in this case. Nevertheless, the total variability of the width of face of the

[1] See footnote on p. 187.

[2] Franz Boas and Helene M. Boas, "The Head-Forms of the Italians as influenced by Heredity and Environment," *American Anthropologist*, Vol. 15, 1913, p. 163 *et seq.*

[3] Franz Boas, "Notes on the Anthropology of Sweden," *Amer. Jour. of Physical Anthropology*, Vol. 1, p. 415 *et seq.*

[4] Boas, *Changes in Bodily Form of Descendants of Immigrants*, Columbia University Press, New York, 1912, p. 76 *et seq.*

half-bloods is almost the same as that of the pure parental types, if anything a little less.[1] If we assume in this case a pure reversion to either type, we should find that the variability would be considerably more than that of the parental races. It appears, therefore, that we cannot generalize with regard to the phenomenon, and we have not the right to assume that mixture will always be accompanied by increased variability and that slight variability does not always indicate purity of descent.

Whenever the laws of heredity are of a still different type, the variability may be affected in a very different manner. Thus it has been shown that mixture between Europeans and Indians results in a stature which exceeds that of the pure Indians, which in turn is greater than that of the pure whites. It is obviously quite impossible to predict in this case what the variability of the series may be.

Another method of investigating mixed descent of a race is by means of a study of the correlations of different measurements of the body. To give an instance: when two people intermingle, one of which has very long and very narrow heads, while the other has very short and very broad heads, and if, furthermore, reversion to parental forms obtains, then we must expect that among the individuals representing this population very broad heads are commonly associated with shortness, while very narrow heads are associated with greater length. We should, therefore, expect of such a population that the broader the head, the shorter it will be. In other cases, where we have a single line of descent, the condition is reversed. The size of the head depends upon the bulk of the body, and since in such a case broad heads are indicative of length of body, the length of head is also increased, and we find that a broad head is associated with greater length of head. In the case mentioned before, the reversion of the normal correlation is indicative of mixed descent.

Here again many variations may occur. If, for instance, we had two races intermingled with a tendency to reversion to parental forms in which the heads of one group are very high and at the same time narrow and short, while those in the other group are flat and at the same time broad and long, then the result would be that in the study of the correlation between length and breadth of head, the correlation would appear inordinately high, because all the shortest heads would belong to the high type and would, therefore, also be narrow, while all the longest heads would belong to the low type and would also therefore be broad.

A characteristic case in which heterogeneity of a series causes abnormal correlation between physical features is found in Italy. Normally there is practically no correlation between hair color and stature, but in Italy the tall Alpine type has lighter hair than the short Mediterranean type. In Piedmont where the Mediterranean type is practically absent we find the following distribution:

Stature	HAIR			
	Red	Blond	Brown	Black
Less than 160	0.5	12.3	64.1	23.1
160–165	0.8	12.4	63.9	22.9
165–170	0.8	12.2	63.4	23.6
170 and more	0.8	12.9	64.3	22.0

In Sicily where the Alpine type is practically absent we find:

Stature	HAIR			
	Red	Blond	Brown	Black
Less than 160	0.3	4.8	56.8	38.1
160–165	0.4	5.1	55.7	38.9
165–170	0.4	5.2	56.6	37.8
170 and more	0.5	5.0	56.6	37.9

[1] Franz Boas, "Zur Anthropologie der nordamerikanischen Indianer," Verhandlungen der Berliner Anthropologischen Gesellschaft, 1895, p. 404 *et seq.*

Louis R. Sullivan, "Anthropometry of the Siouan tribes," Anthropological Papers of the American Museum of Natural History, Vol. 23, pp. 3, 136, 161.

In Venice and Latium, on the other hand, where mixed types occur, we find:

Stature	Venice HAIR				Latium HAIR			
	Red	Blond	Brown	Black	Red	Blond	Brown	Black
Less than 160	0.8	10.1	63.8	25.3	0.7	5.4	60.5	33.4
160-165	0.7	11.9	62.0	25.4	0.6	6.1	60.6	32.7
165-170	0.8	12.8	60.9	25.5	1.1	6.4	60.7	31.9
170 and more	0.8	14.0	61.2	23.6	0.6	8.2	62.4	28.8

and still more clearly for the whole Kingdom:

Stature	HAIR			
	Red	Blond	Brown	Black
Less than 160	0.5	7.0	59.7	32.8
160-165	0.5	7.9	60.0	31.6
165-170	0.6	8.5	60.1	30.8
170 and more	0.6	9.5	61.0	28.8

On account of the greatly varying laws of heredity it is impossible to predict which method of inquiry will lead to a satisfactory result. By some of the means here described the problem of pure or mixed descent may be approached.

The study of any particular type will, therefore, require a multiplicity of investigations, the most important of which relate to the development of the racial type from childhood on, the homogeneity of the series, and the purity of the ancestry. For these purposes the investigations of children and of families are indispensable and must accompany a generalized investigation of the population as a whole.

For the study of the influence of environment the investigation of growing children is, if anything, more important than for the investigation of racial characteristics. After the adult stage has been reached environment will not exert any further influence. The earlier in life the investigation can begin, the more likely we are to obtain adequate results.

In this investigation the generalizing method of comparing local types or types presented in social strata is of little use, because in order to establish definitely an influence of environmental causes, we must be certain that the hereditary composition of the populations which we study is the same. For instance, when we compare a rural and an urban community, there is nothing that will guarantee to us that both populations are derived from the same ancestry. On the contrary, we may assume that the urban population is drawn from a wider group than the rural population. In the same way, when we compare the inhabitants of a long secluded valley and find differences in bodily form between the people living in the lower part and those living in the upper part, the question would arise whether the ancestry of the two groups is the same and whether the people in the upper regions have not been more isolated than those farther down. It is on the whole easier to exclude obvious environmental influences in an investigation of racial types than to exclude differences of racial descent in studies of the influence of environment. The only way to escape from these complications is by confining the studies strictly to a comparison between parents and children.

It has been explained before that in a number of cases we may find apparent hereditary traits which may be deduced from the similarity of parents and their own children, and which nevertheless are primarily due to environmental causes. If we should find, for instance, a low stature among individuals who have been undernourished as children, and if the next generation will also be undernourished, we may have an apparent similarity in stature which is not due primarily to heredity, but rather to the fact that the same environmental causes act upon the parental group and upon the group of children. In most cases these elements cannot be eliminated unless we have the opportunity to study the same racial type in different forms of environment.

It has also been stated that a modification of bodily form due to environment which is observed by comparing parents and their children, does not contradict the phenomena of heredity. If we find, for instance, that the stature of Jewish immigrants into the United States is lower than that of their children, the hereditary stability of stature will nevertheless manifest itself. The children of an exceptionally tall couple who exceed the average stature of the immigrant Jew by a certain amount may be expected to show an excess of stature which is correlated to the excess of stature of the parents, which, however, has to be added to the increased average stature of the children of immigrants. In short, a change in type due to environmental influences simply means that the correlated deviations in the group of parents and of children must be reckoned from the point which is typical for the generation in question.

In some cases in which the environmental influences are very strong, a generalizing method may give adequate results. Bowditch, in his investigation of Boston children, was able to show that Irish children differ in their development according to the economic condition of the parents, and there is little reason to doubt the uniformity of the racial composition of his various Irish groups. But whenever the differences involved are slight, and when they may be equally well explained on the basis of difference in racial composition, the comparison between parents and children is indispensable. The data for the study of environmental influences must, therefore, be based on the comparison of the bodily forms of parents and their offspring. In this manner the doubt as to the difference in racial composition may be eliminated, although it is at least conceivable even in this case that there may have been selective rather than environmental influences. It might be said, for instance, that when some parents have children in charitable institutions while other children stay at home, differences between the two groups of children might not be due to environmental influences only but also to selection. This example indicates that care must be taken to eliminate the influences of selection even when we are dealing with family groups in which diversity of racial descent has been excluded.

At the present time it is unknown to what extent the influences of environment may determine bodily form. Notwithstanding the numerous claims of the fundamental effect of climate upon the body of man, we have no evidence whatever that will show that pigmentation undergoes fundamental changes under climatic conditions; that the white race would become darker in the tropics; or that the negroes would become lighter in the north. Whatever statistics we have on this subject show rather a remarkable stability of pigmentation. We have not even any definite indication that the pigmentation of the hair undergoes changes under different climatic conditions, although in this case the change in color from the period of childhood until middle life is so great that we might very well expect environmental influences to express themselves. On the other hand, we know that the bulk of the body is very susceptible to environmental influences, and it is but natural that retardation or acceleration during the period of growth will also leave their effect upon those proportions of the body which depend upon bulk. Other changes which occur very early in life are not so easily explained. I think the evidence showing that the form of the head is susceptible to environmental influences is uncontrovertible. I also believe that adequate proof has been given for modifications in the width of the face under changed conditions of life. The causes of these changes are still entirely obscure. It may well be, as suggested by Harvey Cushing, that chemical changes occur under new environmental conditions and unequally influence growth in different directions. This would agree with the changes in chemical constitution found in

lower animals living in different types of environment. If it is true that changes of this kind do occur and modify the form of body so fundamentally that according to the ordinary schemes of classification a people might be removed from one group and placed in another one, then we have to consider the investigation of the instability of the body under varying environmental conditions as one of the most fundamental subjects to be considered in an anthropometric study of our population.

THE DETERMINATION OF SECULAR TREND[1]

By W. L. Crum, *Yale University*

It is customary in the analysis of ordered statistical series of the historical economic sort to eliminate the growth factor, assumed constant, by fitting a straight line to the original data. The equation of this straight line is determined by the method of least squares [2] or by an equivalent process. At a later stage in the investigation, it is frequently desirable to consider the ratio of the deviation of a particular variate from the ordinate of the corresponding point on the line of secular trend to that ordinate, rather than the actual deviation itself.[3] The question arises whether it would not be preferable to fit the line so that the sum of the squares of these *ratios*, rather than the sum of the squares of the actual *deviations*, is minimum. It is the purpose of this paper to examine this question and to get a first approximation to the position of the line of secular trend on the new basis.

I. THE COEFFICIENT OF CORRELATION

Suppose we have a series of N—N being assumed odd for convenience—variates x_i ordered relative to a variable t_i. We suppose further that the intervals between successive t_i are all equal and equal to unity, and we therefore represent the t_i as i; and moreover we take the middle t_i as origin. Finally, we restrict the problem to cases in which the secular trend is substantially rectilinear and gradual, and in which the total change in x is not a large fraction of the mean x. This would amount to saying, somewhat loosely, of a historical series, that it represented a phenomenon in a mature stage of development.

Let the position of the line of secular trend, Figure 1, be specified by two of the parameters:

a, the x-intercept; m, the slope; T, the negative t-intercept; which are related by the equation:

$$a = mT \tag{1}$$

Then, the equation of the line is:

$$x = m(i+T) \tag{2}$$

[1] Presented to the American Mathematical Society on December 28, 1921, under the title "Note on the determination of the rectilinear secular trend of an ordered series of statistical relatives."

[2] Warren M. Persons, *Review of Economic Statistics*, Jan., 1919, p. 12.

[3] *Ibid.*, p. 35, and April, 1919, p. 117 *et seq.*

the actual deviation of a particular variate, x_i, is:

$$x_i - m(i+T)$$

and the ratio of this deviation to x is:

$$\lambda_i = \frac{x_i}{m(i+T)} - 1. \tag{3}$$

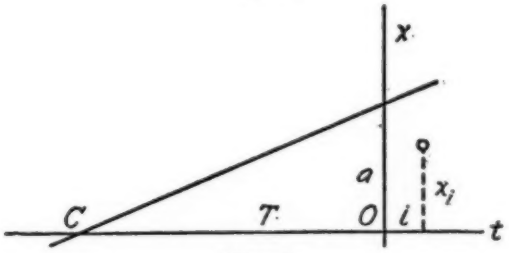


Fig-1

Because of the limitations placed upon the series, it is possible to expand in powers of $u_i = i/T$, and (3) becomes approximately:

$$\lambda_i = \frac{x_i}{mT}(1-u_i) - 1$$

$$= \frac{x_i}{a} - 1 - \frac{x_i}{a}u_i$$

$$= P_i - p_i u_i \tag{4}$$

where

$$p_i = x_i/a, \; P_i = p_i - 1.$$

Moreover

$$\lambda_i^2 = P_i^2 - 2P_i p_i u_i. \tag{5}$$

Suppose now that there is a second series of N variates, y_i, ordered relative to t_i, and subject to the same sort of limitations as the x series. We imagine that there is a certain "lag" between the two series, so that the t which belongs to the *ith* y differs from that belonging to the *ith* x by an amount L; and this lag, L, will be assumed constant. Then, if we take the y-axis at a distance L from the x-axis, values of x and y belonging to the *same* value of i will be associated with each other; and the analysis can proceed without further regard for the existence or amount of lag.

To distinguish between the two series, we suppose from now on that the above parameters for the x series are a_x, m_x, T_x, and that corresponding parameters for the y series are the same letters with subscript y. Moreover, for the y series, we use μ_i, v_i, q_i, and Q_i to correspond to λ_i, u_i, p_i, and P_i.

With this notation we get the following set of approximate relations:

$$\left.\begin{aligned} \lambda_i &= P_i - p_i u_i \quad , \quad \mu_i = Q_i - q_i v_i \\ \lambda_i^2 &= P_i^2 - 2\,P_i p_i u_i \ , \ \mu_i^2 = Q_i^2 - 2\,Q_i q_i v_i \end{aligned}\right\} \tag{6}$$

and the typical product term, which enters in the correlation coefficient, is:

$$\lambda_i \mu_i = P_i Q_i - Q_i p_i u_i - P_i q_i v_i + p_i q_i u_i v_i. \tag{7}$$

Whereas, by the assumptions about the series, p_i and q_i are not far from unity; u_i and v_i are of the first order in the small quantity—the ratio i/T—and it is possible that the same is true of P_i and Q_i, if a_x and a_y are not far from the arithmetic means. Thus all the terms in each of the expressions (6) and (7) are likely to be of the same order. If we were concerned with the actual deviations, the means, standard deviations, and correlation coefficient would depend upon the terms P_iQ_i, P_i^2, Q_i^2 and P_iQ_i. But, in the analysis from the point of view of the ratios λ and μ, the additional terms are likely to be equally important.

Granting that it is essential to keep all the terms in the above expressions, will their values be altered greatly if the lines of secular trend are determined by considering the ratios λ and μ, rather than the actual deviations? It is shown below that the values of a, as found by the two methods, do not differ greatly from each other. But the other parameter, T, and hence also m, is likely to be changed notably by applying the method of least squares to the ratios instead of the actual deviations. Hence, as T_x enters in u and T_y in v, the above values are all likely to suffer considerable change. It is therefore doubtful if it is warrantable to compute the correlation coefficient of the ratios unless the line of trend for each series is located on the basis of ratios.

II. FITTING THE LINE

We proceed next to fit a line to the x series by the method of least squares, basing the calculations upon the ratios instead of the actual deviations: we seek to determine the parameters a, m, and T so that the sum of the squares of the λ_i shall be minimum. The *necessary* conditions for a minimum are that the partial derivatives of $\Sigma\lambda_i^2$ with respect to m and T shall vanish.

The exact expression for λ_i is given in (3) as:

$$\lambda_i = \frac{x_i}{m(i+T)} - 1$$

from which

$$\frac{\partial \lambda_i}{\partial m} = -\frac{x_i}{i+T}, \quad \frac{\partial \lambda_i}{\partial T} = -\frac{x_i}{m}$$

giving

$$\frac{\partial \Sigma \lambda_i^2}{\partial m} = -2\sum \frac{x_i}{i+T}\lambda_i, \quad \frac{\partial \Sigma \lambda_i^2}{\partial T} = -2\sum \frac{x_i}{m}\lambda_i. \tag{8}$$

Each of these exact relations (8) is expanded in powers of u, and set equal to zero. Solving the two resulting equations simultaneously, and using (1), will give the following approximate values of the parameters:

$$m = \frac{1}{T}\frac{\Sigma x^2}{\Sigma x} \tag{9}$$

$$T = \frac{3\,\Sigma x \Sigma x^2 i^2 - 2\,\Sigma x^2 \Sigma x i^2 - \Sigma x i \Sigma x^2 i}{\Sigma x \Sigma x^2 i - \Sigma x^2 \Sigma x i} \tag{10}$$

$$a = \frac{\Sigma x^2}{\Sigma x} \tag{11}$$

The quantities involved in (9), (10), (11) are:

$$\Sigma x,\ \Sigma x i,\ \Sigma x i^2,\ \Sigma x^2,\ \Sigma x^2 i,\ \Sigma x^2 i^2$$

and these are the moments of orders 0, 1, 2, of the x and the x^2. The computation of the parameters which locate the line necessitates, then, the calculation of these six moments.

Example (i). Consider the following ordered series:

x	2	3	2	4	3	2	4
i	−3	−2	−1	0	1	2	3

The above formulas give for the intercepts:

$$a = 3.1; \quad T = 17.2$$

whereas computation by the usual method of least squares of the *deviations* gives:

$$a = 2.9; \quad T = 16.3.$$

The series is shown in Figure 2; and the two lines are plotted, the full line being that of the present method of calculation.

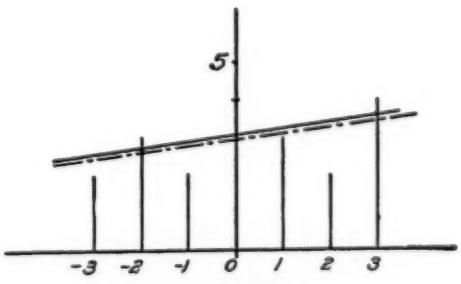


Fig-2

Example (ii). Examination of the ordered series:

x	9	9	10	8	9	11	10	12	11
i	−4	−3	−2	−1	0	1	2	3	4

gives:

$$a=10.0; \quad T=62.2$$

by the method of *ratios;* and, by the method of *deviations:*

$$a=9.9; \quad T=29.7.$$

This series and its two lines are shown in Figure 3.

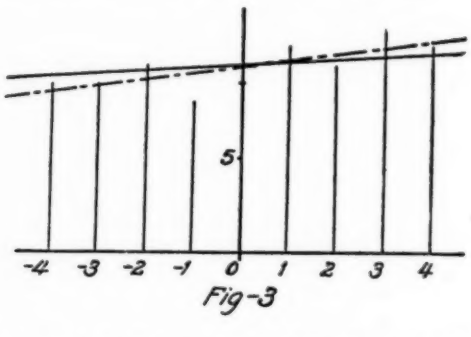


Fig-3

Example (iii). We study next a series of the historical economic type, the monthly values of building permits for twenty leading cities over a period of sixteen years as shown in the table[1] that follows. Calculation on the basis of ratios gives for the parameters:

$$a=440; \quad T=3130; \quad m=.14$$

whereas the determination depending on the actual deviations gives:

$$a=398; \quad T=1470; \quad m=.27$$

These last values are not the same as those found from the equation as given by Professor Persons,[2] but the discrepancy is due to the fact that he used only the first fourteen years of the series in fitting the line.

We observe that in each of the examples the values of a found by the two methods are not greatly different from each other, and that the value found by the ratio method exceeds that found by the older method. This is true in general, for:

$$a=\frac{\Sigma x^2}{\Sigma x}=a'\left\{1+\left(\frac{\sigma}{a'}\right)^2\right\}$$

where a' is the arithmetic mean, and σ is the standard deviation, of the x_i. But a' is precisely the value of a found by the older method;

[1] *Rev. of Econ. Stat.*, January, 1919, p. 74.
[2] *Ibid.*, p. 39.

	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18
January	169	169	234	346	357	160	359	334	345	276	314	298	267	349	343	212
February	201	133	289	317	332	168	428	337	272	313	335	313	301	320	324	173
March	416	317	522	494	510	279	616	609	510	497	467	547	464	549	495	190
April	328	396	495	617	673	422	714	614	543	650	548	489	499	563	476	286
May	343	333	461	530	632	355	662	518	427	594	506	506	531	673	412	259
June	310	399	546	543	555	464	621	501	564	576	490	519	402	636	368	243
July	282	388	461	491	456	422	607	433	499	483	444	506	405	880	340	246
August	266	313	485	478	387	338	489	426	631	520	393	342	448	393	290	225
September	189	355	463	439	336	365	487	414	466	368	391	339	435	400	292	185
October	246	312	377	458	378	473	418	419	407	411	366	311	438	583	235	118
November	207	309	381	397	231	446	381	428	379	385	295	218	419	425	248	81
December	182	258	292	339	217	341	372	365	336	468	438	237	443	442	170	

MONTHLY VALUES OF BUILDING PERMITS ISSUED FOR TWENTY LEADING CITIES
Original items in units of $100,000

and the ratio σ/a' is small because of the initial restrictions imposed upon the series.

On the other hand it is clear that the values of T may be closely alike or widely different, depending upon the form of the series. It is this fact which justifies the practical conclusion of Part I.

It has not been the purpose of this paper to secure greater refinement in the computation of the correlation coefficient for ordered series. Indeed, it is sought here to point out the lack of justification for as great refinement as is ordinarily used. The fact is that we are still far from our goal of securing a satisfactory index of the correspondence between two ordered series. It is worthy of note that in its magnificent work the Harvard Bureau uses the coefficient chiefly to determine the lag between two series. It has seemed advisable to work out the above relations; for, however uncertain is our knowledge of the exact portion of a particular variation in a historical series which is assignable to "secular growth," from a mathematical point of view the position of the line is one of the most precise things with which we deal. Further study of the line, as determined on this new principle, may increase our knowledge of the correlation between ordered series and point the way to a new method of separating out the "cyclical" portion of the variation in historical series, to examine which is usually our ultimate object.

THE WORK OF DREYER IN RELATION TO LIFE INSURANCE EXAMINATIONS[1]

By Louis I. Dublin, *Metropolitan Life Insurance Company*

The subject, "The Assessment of Physical Fitness," commends itself especially to an audience of life insurance medical directors. For to assess physical fitness of applicants for insurance is exactly their function. One could hardly have hit upon a more apt title than has Dr. Georges Dreyer, of Oxford, for his recent book. When you pass upon an applicant for insurance, you assess his physical fitness on the basis of his structural and functional normality. You look for sound heart, lungs, and kidneys, for sound mind, and for evidence of normal health in the applicant's appearance and his ability to carry on his daily work. Recently, you have turned to such supplementary evidence of physical fitness as that afforded by the interrelationship of height and weight according to age. There are, of course, other items, such as occupation, habits, and the living conditions of the applicant, which assist in forming a judgment of what constitutes a standard risk. Your basic assumption is that every one of the points referred to has a definite and measurable effect on longevity, and that in their totality they give a fairly good guide for classifying applicants into those who will and those who will not measure up to the expectation of the mortality tables used as a basis for the calculation of premiums.

Dr. Dreyer is not concerned with life insurance examinations. He is interested primarily in developing a series of norms for distinguishing those who are physically fit from those who are not. These norms are based on the interrelationships existing between a limited number of bodily measurements, which are as follows: weight, height sitting or stem length, and circumference of chest and vital capacity as measured by the spirometer. These measurements, which are easily made, Dreyer believes give a clue to physical fitness. He has discovered, he says, the true relationships which exist between these four measurements in the healthy individual. By actually applying the normal relationships to individual cases, he thinks he can distinguish those who are physically fit from those who are not.

Dreyer expresses the relationships between the four measurements

[1] Read at the Annual Meeting of the Association of Life Insurance Medical Directors, October 20, 1921.

The writer desires to express his obligation to Professor C. C. Grove and Miss Margaret E. Gantt, of the Statistical Bureau, for their valuable assistance in the preparation of this paper.

referred to in a series of simple formulas. Each one of these gives the value of one of the measurements in terms of one of the others. Thus, there are formulas which express the relationship between the weight and the stem length, between the weight and the chest girth, between the chest girth and the stem length, and between each one of these three measures and the vital capacity. These six formulas are applicable to persons up to age 50. There is a set for males and one for females, the two sexes being very different in the interrelationship of their measurements. To obviate calculations, the author in his book has appended a number of tables which express the values of these measurements in terms of each other. Thus, for each stem length in centimeters, a table gives the corresponding weight in kilograms; another table gives the weight corresponding to chest girth. It is possible from the tables to read off what all the measurements of a normal individual should be from any one of the four that may be given. There are two sets of tables for both males and females, one in the metric system, the other in the American or English system of weights and measures.

Dreyer presents a number of apt illustrations which show concretely the uses of his tables. The problem is to determine whether or not an individual is physically fit according to his actual measurements. Given the four measurements, he finds first the expected weight from the stem length and also from the chest measurement. If these agree with the actual weight, the person has normal proportions. But in many instances he finds normal persons whose theoretical weights according to stem length and according to chest girth are different. In such cases he takes the average of the two theoretical weights and compares that average with the actual weight to determine the individual's fitness. If the individual has a normal weight, he then finds the theoretical vital capacity from the actual weight. He compares that figure with the actual vital capacity to determine the percentage deviation from the theoretical vital capacity. If an individual has a weight which is 5 per cent from the normal, he possibly has an abnormal weight; if he differs from the normal by as much as 10 per cent, he is probably abnormal with respect to weight; and if the deviation reaches as much as 15 per cent, his weight is certainly abnormal. Individuals may be abnormal as to weight and still be physically fit. If they are overweight and their vital capacity is commensurate with their added weight, they are considered physically fit because they have a larger vital capacity than would be expected from their stem length and chest. On the other hand, persons who are underweight for their stem length and chest may be physically fit if their vital capacity is commensurate with their stem length and chest. The following are two illustrations,

the one being taken from Dreyer's examples of a person who is normal in all respects, and the other improvised to illustrate a person who is physically unfit according to the Dreyer standards:

ILLUSTRATION 1[1]

Female, age 21 years

Observations

Weight of body = 62.0 kilograms
Length of trunk = 88.8 centimetres
Circumference of chest = 75.0 centimetres
Vital capacity = 3,630 cubic centimetres

Calculation

Weight derived from length of trunk (88.8 cm.) = 64.71 kilos (from Table VII).

Weight derived from circumference of chest (75.0 cm.) = 59.16 kilos (from Table VIII).

Averaging $\frac{64.71+59.16}{2}=61.9$ kilos, which is the normal weight corresponding to the observed length of trunk and circumference of chest.

Subtracting the calculated weight from the observed weight,

$$62.0-61.9=+0.1 \text{ kilos}$$
$$\frac{+0.1\times100}{61.9}=+0.2\% \text{ (or roughly } 0\%).$$

Therefore the person weighs exactly what she should weigh according to the tables.

Since by the above calculation the person's weight is found to be normal, the vital capacity as calculated from the observed weight will be correct; therefore:

Vital capacity derived from weight of the body (62.0 kilos) = 3,556 cc. (from Table X, Class A).

Subtracting the calculated from the observed vital capacity,

$$3{,}630-3{,}556=+74 \text{ cc.}$$
$$\frac{+74\times100}{3{,}556}=+2.08\% \text{ (or roughly } +2\%).$$

[1] Taken from Georges Dreyer and George F. Hanson, *The Assessment of Physical Fitness*, American ed., Paul B. Hoeber, New York, 1921, p. 109.

Therefore the person has 2 per cent greater vital capacity than she should have according to the tables for Class A, calculated from the weight of the body.

ILLUSTRATION 2

Male, age 25 years

Observations

Weight of body = 121 lb. 3 oz.
Length of trunk = 34⅞ inches
Circumference of chest = 33½ inches
Vital capacity = 3,272 ccm.

Calculation

Weight from stem length = 135.35 lb.
Weight from circumference of chest = 137.99 lb.
Averaging above weights = 136.67
∴ Person is 11.3 per cent underweight.

The vital capacity if obtained from the actual weight would be too low for the stem length and the chest girth. We therefore calculate the vital capacity from the stem length and the circumference of chest as follows:

Vital capacity from stem length = 4,061 cc.
Vital capacity from chest circumference = 4,118 cc.

The average is 4,090 cc.

The actual vital capacity is 20 per cent below normal by stem length and chest circumference.

This individual is, therefore, not in physically fit condition according to Dreyer.

These two illustrations show how Dreyer's tables may be used to discover individuals who are physically fit or are abnormal according to his standards. He is particularly convinced of the value of the vital capacity as an index of physique and health. By applying his values for vital capacity to the measurements of a large number of tuberculous patients, he has been able to determine the stage of tuberculosis, to give the prognosis in these cases, and to indicate the benefit derived from sanatorium treatment. He believes that his measures disclose the existence not only of tuberculosis but of other diseases as well. This phase of the work has been confirmed by a number of other observers for cases of tuberculosis and of heart disease.

Obviously, a work which promises to do all of this should be of the greatest interest to life insurance executives. For if we can through a

series of simple measures really distinguish the fit from the unfit, we have made an important advance. But before we can accept as demonstrated so epoch-making a contribution we must be very sure that the premises are correct and that the conclusions are sound. Let us then see how nearly the conclusions of Dreyer are justified by the internal evidence presented, and to what extent the conclusions can be applied to the life insurance business. To evaluate the work of Dreyer it is necessary not only to read his book but to study very carefully a number of highly technical papers which he has issued from time to time. The most important of these papers appeared in the *Lancet*, August 9, 1919, and was entitled, "The Normal Vital Capacity in Man and Its Relation to the Size of the Body." In this paper he derives the various formulas which express the relationships existing between the four measurements already referred to. The relationships are worked out from the measurements of 16 males who ranged in age from 13 to 52 years and were selected for their physical fitness.

Strangely enough, Dreyer does not use the same formulas in his book as in his *Lancet* paper. The following parallel columns will show the differences:

COMPARISON OF FORMULAS FOR VARIOUS MEASUREMENTS FOR MALES[1]

[1] W=weight in grammes; λ=length of trunk in centimetres; Ch=circumference of chest in centimetres; VC=vital capacity in cubic centimetres.

	Book	*Lancet* paper
(1)	$W = .38025\sqrt[.319]{\lambda}$	$\lambda = \frac{W^{\frac{1}{3}}}{.449}$ or $W = .0905\sqrt[.33]{\lambda}$
(2)	$W = .662\sqrt[.365]{Ch}$	$Ch = \frac{W^{\frac{1}{3}}}{.457}$ or $W = .0954\sqrt[.33]{Ch}$
(3)	$Ch = \frac{\lambda^{1.1442}}{2.00148}$	not given
(4)	$VC = \frac{W^{.72}}{.69}$	$VC = \frac{W^{.72}}{.69}$
(5)	$VC = \frac{\lambda^{2.257}}{6.1172}$	$VC = \frac{\lambda^2}{1.9}$
(6)	$VC = \frac{Ch^{1.973}}{1.5595}$	$VC = \frac{Ch^2}{1.82}$

Formulas (1) and (2) for males as given in the book are very unlike those in the *Lancet* paper. They are, moreover, not the ones from

which the tables in the book were computed. As might be expected, they are not consistent with the other formulas. Number (1) should read $W = .0483\sqrt[.319]{\lambda}$, and number (2) should read $W = .3229\sqrt[.365]{Ch}$. With these corrections, the six formulas of the two series agree very closely even if they do not appear to on first inspection. There are similar discrepancies in the formulas presented for females. $W = .36093\sqrt[.313]{\lambda}$ should read $W = .03856\sqrt[.313]{\lambda}$, and $W = .30213\sqrt[.284]{Ch}$ should be $.01478\sqrt[.284]{Ch}$. Otherwise the formulas are consistent and are used in compiling the tables. It is difficult to understand how these errors have crept into the book. But they are there.

Let us now consider the set of formulas as corrected. Do they truly express the relationship between the various measurements that we are considering? To answer this question we attempted to derive the formulas independently. By the method of least squares we obtained a series of values which fitted the facts pretty well but which did not present so close a fit as the values obtained by Dreyer. We did not exactly duplicate any of the Dreyer formulas, although we could approximate a number of them on theoretical grounds. It must be admitted that his formulas fit the data for the 16 males better than any other values we could obtain. Let us examine some of these formulas separately.

$$VC = \frac{W^{0.72}}{0.69}$$

This formula is the most important in the series. On applying it to each one of the 16 individuals, we found only one whose actual vital capacity deviated considerably (+6.7%) from that predicted by the formula. But in view of the fact that an excess of vital capacity is a favorable feature, no fault can be found with the fit of the formula to these individuals. Similarly, Dreyer applied this formula to the material of Schuster, and he shows that the relationship between weight and vital capacity in this large group of Oxford undergraduates as a whole is in accordance with the formula.

We have in like manner attempted to apply this Dreyer formula to a group of Harvard undergraduates[1] and have found that these boys, with few exceptions, had a higher vital capacity than that predicted by the formula according to their weights. This finding does not in itself impair the value of the formula, because, as Dreyer says, the vital capacities he has given are averages for fit individuals and may be exceeded by highly developed and athletic persons.

[1] West, "Clinical Studies on the Respiration," Arch. of Int. Med., vol. 25, p. 306.

His other formulas are not quite so fortunate. Let us take the one expressing vital capacity in terms of stem length. The formula is:

$$VC = \frac{\lambda^2}{1.9} \text{ or } \frac{\lambda^{2.257}}{6.1172}.$$

When applied to his 16 individuals, we find that one person, No. 12, has a vital capacity which is 20 per cent in excess of that predicted, whereas No. 16 is 13 per cent below. There are altogether 6 individuals whose vital capacity is at least 7.85 per cent above or below the normal. If we use the formula given above (used in his book) we find that there are 6 individuals whose vital capacity is at least 6 per cent above or below the expected. These are presumably fit persons, and since there are 2 individuals out of 16 who are seriously below the expectation, it would seem either that there is something wrong with the formula as an expression of fitness or that there are wide limits between which fit individuals can be found. These deviations from normal vital capacity are almost as marked as are those calculated from height standing according to Hutchinson's method, which Dreyer insists has no value.

Nevertheless he places great confidence in this expression for vital capacity and height sitting and prefers it even to the previous formula showing vital capacity in relation to weight, because, as he points out, weight may change rapidly but stem length does not.

Likewise his formula for vital capacity and chest,

$$VC = \frac{Ch^2}{1.82} \text{ or } \frac{Ch^{1.973}}{1.5595},$$

shows a considerable range of deviation for his 16 individuals. There are 5 persons in his series who are all the way from 6 to 10 per cent below the expected vital capacity. Yet he insists that the vital capacity of fit persons must not fall so much as 10 per cent below the normal. Following out his own procedure we averaged the calculated vital capacities as obtained from both stem length and from chest. We found by this method that of the 16 persons specially chosen for their physical fitness, 3 had a vital capacity 7 per cent or more below the normal. One of these, No. 16, is 8.8 per cent below, which is close to the limit for "probably" unfit individuals according to Dreyer's standards. This same individual is 7.7 per cent underweight for his stem length and chest girth, and 3.1 per cent under vital capacity even for his underweight.

There is another line of evidence that all is not well with these formulas. Take, for example, the relation between weight and stem

length and weight and chest. Dreyer, equating the two formulas, concludes that "in the normal healthy man the circumference of the chest is, on the average, about 1.5 per cent smaller than the stem length, though in a fair number of the individual cases the chest measurement may be greater than the stem length." On applying this test to his own series we find that 4 out of the 16 individuals have chest girths 4.5 to 6.2 per cent greater than their stem length, and 4 more have chest girths from 5.5 to 10.1 per cent less than their stem length. There is, obviously, too much variation to satisfy the rigid expressions laid down by Dreyer. The conclusion drawn from these several discrepancies is that Dreyer attaches more value to his formulas than is justified by the facts. The proper relationship between the several measures must be expressed in terms of a measure of correlation with limits between which the variables may fluctuate.

So far we have referred to the formulas for males only. One half of Dreyer's book is given over to tables for females which show the relationships existing between the four measurements heretofore discussed. These tables are constructed on the basis of formulas similar to those for males. But nowhere does Dreyer give us any clue as to how these formulas were obtained, how many lives they were based upon, and whether they have been confirmed by others. In fact, they are interjected into the book without any explanation. I have already called your attention to errors in the two basic formulas for weight in terms of stem length and chest. But even a very cursory examination of the tables and the formulas shows that they are inconsistent with some of the well-known facts with reference to the relation of build of women to that of men. For example, Dreyer's tables show that for the same stem length or height sitting, women are heavier than men. For a height sitting of 35 inches, a male according to Dreyer should weigh 137 pounds and a female, 143 pounds; that is, a female is about 5 per cent heavier. But we know that for the same height standing, females are a little lighter than males. The anthropologists tell us that females have a relatively greater height sitting than males. Therefore it would follow that for the same height standing, females would be lighter according to our standard tables of height and weight, whereas they would have longer stem lengths and, therefore, appreciably greater weight than the males according to the Dreyer tables which are correct. The discrepancy is really very considerable, and I am inclined to say that for the present at least no use can be made of that section of Dreyer's book which relates to females.

The important question for us today is what use we can make of the Dreyer work. I will say frankly that as yet its use is very limited.

The Dreyer researches are still in an experimental stage. We should hesitate to apply to practical business affairs standards which are likely to be greatly changed when derived from the measurements of larger groups of people whose physical condition is more definitely known than was the physical condition of the group reported upon by Dreyer.

But quite apart from the accuracy of the formulas, there is the fundamental question as to their significance. Dreyer insists that they express the relationship between the various measurements in physically fit people, and that they can be used to distinguish between those that are physically fit and those that are not. Unfortunately, this is the weakest spot in the entire work. For what is meant by "physical fitness"? If this is an expression merely of the general vigor of an individual or of individuals as determined by their appearance, then, obviously, there is little value for us in the characterization. We know only too well that individuals of good general appearance may on careful examination be found to be suffering from serious physical defects. If we assume that the 16 persons who made up Dreyer's series and the other groups which also confirm his findings were persons who on actual physical examination were found to be free from organic disease, then we have a better basis. But even then the applicability of the work to insurance must be limited. For in the last analysis the insurance examiner is concerned with fitness in the sense of the ability to live. This is the one test of physical fitness which insurance constantly has in mind. In this sense physical vigor is not the only consideration. Personal history, habits, and a host of other items enter as determinants of longevity. "Physical fitness" and "longevity" are far from synonymous. We know that certain races are notoriously long-lived, but are not physically well developed; that females have greater longevity but poorer physique than males, and that certain occupations, especially where the work is sedentary, lead to the development of poor physique, but do not necessarily involve a short life span for the workers.

It must be clear, therefore, that from the insurance standpoint the Dreyer work is at its inception. What is necessary for us is a series of measures of the Dreyer type which are definitely known to express relationships among individuals who correspond in insurance language to standard lives. We must avoid loose or vague expressions. By standard lives, as opposed to the physically fit, we mean individuals who will give a subsequent mortality corresponding to our usual tables. With reference to Dreyer's fit persons we can say nothing as yet. The problem then resolves itself into tracing the subsequent mortality of various groups of individuals whose relative indexes are known. We shall in

that way build up a fund of information which is likely to be very useful to us.

Yet the work is very suggestive, and it would be entirely unfair to leave the impression that there is no utility for us in Dreyer's studies. He has opened up a wide field for further investigation. The most fruitful contribution for insurance purposes is likely to come out of a revision of the indexes giving the relationship between height sitting, chest girth, and weight. We shall have to forego the idea of perfect correlation between these three measurements and attempt rather to find the limits of their variability among standard lives. A series of tables should be prepared showing, for example, the distribution of weights for each inch of height sitting and the mortality experience of each combination. A similar table for chest girth and weight would be needed. Research might show that the best results for insurance work follow from a combination of chest girth and height sitting in relation to weight. Such tables will agree better with the known facts of human variability than do Dreyer's rigid formulas which leave, theoretically at least, little or no room for variation from the type.

The height and weight tables we now use in insurance work illustrate the other extreme, that is, much variability of weight with reference to total height. For the weights for any given height may vary enormously from the average. In height and weight relationships there is a very wide range instead of concentration at the average. Furthermore, mortality is apparently not seriously affected by this extreme range of variability, for individuals may be as much as 30 or even 40 per cent below the average and still enjoy standard mortality. For underweights, at least, our height and weight tables have apparently little value. The coefficient of correlation between total height, weight, and mortality is too low to give useful indexes for insurance purposes.

It is because of this defect in the height and weight tables that Dreyer's alternative measurements for height sitting, chest girth, and weight may prove of the greatest value. These three measurements are much more closely correlated than are height standing and weight. The limits of variability will be found to be much less. It is only necessary to identify the various combinations with the facts of mortality. This has not yet been done. It is the chief suggestion that arises out of the consideration of Dreyer's work. For it is possible that when further investigation is carried out, we shall have guides as to build which will be very much better than the height and weight relationships we now use.

The relationship of vital capacity to weight, although probably the most accurate in the whole series presented by Dreyer, is one which

unfortunately is not adapted to the insurance business on a large scale. Spirometer readings can be very much modified through exercise, and it would be entirely possible for an applicant with a low spirometer reading to increase his vital capacity very appreciably through exercise and practice without materially improving his health. Spirometers are rarely, if ever, found in physicians' offices, and the use of this rather expensive instrument must be limited to laboratories. It is conceivable, however, that the method may be useful in clearing up some doubtful cases in which the build of the applicant suggests defects which are not proved on the examination. Take, for example, an applicant who is overweight 30 per cent and who otherwise presents a good picture of physical health. According to present practice we should be suspicious of him, especially if the amount of insurance were considerable. Our practice would be to reject him or to offer him sub-standard plans. But suppose the individual has the predicted weight for his stem length and chest measure and the normal vital capacity for his weight. It is then probable that such a person would prove a much better risk than the applicant who was overweight for his other proportions and whose vital capacity was too low for his extra weight.

It is possible, however, that the relationships between vital capacity and the other measurements may prove useful in singling out cases of incipient tuberculosis. Dreyer's work seems to indicate that there is a much lower vital capacity among persons in that condition. The Dreyer measures might serve as one more guide in forming a judgment on such applicants. In the same way, the Dreyer measures for vital capacity when applied to cases of arrested tuberculosis might very well indicate which were the safest risks.

But the chief value to us in Dreyer's work lies in the future. He has opened up an obviously rich field for further investigation. It may well be that the insurance companies are the best agencies for revising his formulas and for adding to their value. For such units as they will prepare will measure the very definite character of longevity rather than the vague condition of physical fitness. I am inclined to believe that many contributions will be made at the future meetings of this association by members engaged in revising and refining the very fertile work of our author.

CYCLES OF EMPLOYMENT AND UNEMPLOYMENT IN THE UNITED STATES, 1903–1914

By W. A. Berridge, *Harvard University*

In the first of these articles on employment and the business cycle,[1] a current index of employment in the United States was proposed, extending from the outbreak of the war to date. A half-dozen or more employment and unemployment series were examined, but only two were found to have all the characteristics naturally expected of a reliable current index. Accordingly, a combination of these two—properly corrected for seasonal variation, etc.—was proposed as a good index for present use, extending back far enough into the past to afford an adequate basis for the interpretation of current fluctuations. These two series were found to be strongly supported by the others. The high order of correspondence is shown by the correlation coefficients: the United States Bureau of Labor Statistics with the New York State Industrial Commission series (1915–21) +95 per cent; an adjusted combination of these two, with the Wisconsin series (1915–21) +98 per cent; the adjusted combination, with the Massachusetts employment series (1914–20) +80 per cent; adjusted series representing Massachusetts employment and unemployment (1914–20) −89 per cent.[2] The general employment index was found to bear striking relationships to military mobilization and demobilization, and to Day's monthly index of the production of manufactures, corrected for the varying length of month. The correlation between industrial employment and production was found to be 96 per cent.[3]

The purpose of this second article is: (1) to present an index of employment applicable to general industrial conditions in this country in the ten or fifteen years before the war; (2) to check up this index with the United States Censuses of Manufactures; and (3) to compare employment with direct measures of production before the war. The method utilized is, as before, the index method, without reference to that somewhat illusory concept, "the quantity of unemployment."

The two best employment series now current are of no assistance in studying pre-war relationships, not having been begun until early in

[1] This Journal, vol. XVIII, pp. 42–55, Mar., 1922.

[2] Coefficients were not computed for the shorter series, such as that of the U. S. Employment Service.

[3] Since the writing of the first article, in January, Professor Day has tentatively estimated and eliminated the seasonal variation of his production series. His new results, compared with the adjusted employment index, appear in the *Harvard Economic Service*, vol. I, p. 73, *Weekly Letter* no. 13, Mar. 25, 1922. The correlation with his new series is also 96 per cent.

the war. Three other bodies of evidence are available which are similar in their nature, relating to the numbers employed in manufacturing establishments. These have been collected by the United States Census of Manufactures and by the state bureaus of statistics in New Jersey and Massachusetts. Furthermore, two unemployment series collected by the state bureaus in New York and Massachusetts are of assistance in constructing a general pre-war index of employment. Our first task is a critical review of these five bodies of evidence.

DIRECT MEASURES OF EMPLOYMENT

Employment data for Massachusetts.—Since 1889 the Massachusetts Bureau of Statistics has collected, early in each year, data showing the number of wage-earners on pay-rolls at the middle of each month during the preceding year in the most important manufacturing establishments of the state. The results have been published in the *Annual Reports on the Statistics of Manufactures*.[1] The aggregate number of wage-earners covered by these reports has ranged from 150,000 to 800,000. Although the data are very comprehensive they have not remained equally so throughout the period. Thus in 1899 about 360,000, or 82 per cent of the 438,000 wage-earners shown by the United States Census for Massachusetts, were covered by the reports of the state bureau; by 1904 the number had risen to 430,000 or 88 per cent, and in recent years it has become even larger.[2]

An important peculiarity of manufacturing in Massachusetts is the degree of industrial specialization, particularly in the manufacture of cotton goods. Cotton manufacturing forms between 16 and 26 per cent of the total manufacturing in the state, as contrasted with the figure of 6 per cent representing the quota of the cotton industry in the entire country. In other words, about 30 per cent of the country's cotton manufacturing is carried on in Massachusetts.[3] The boot and shoe industry also ranks high, constituting 10 to 16 per cent. Woolen and worsted goods, and foundry and machine-shop products, are groups of about equal importance, each employing 7 to 12 per cent of the total number of wage-earners. These four industrial groups comprise 40 to 55 per cent of all manufacturing in Massachusetts. Industrial specialization is one factor which renders the Massachusetts returns imperfectly representative of general industrial conditions. Moreover,

[1] The figures for 1919 and 1920 were kindly supplied by Mr. Roswell F. Phelps, Director of the Bureau. Those for 1921 have not yet been tabulated.

[2] It is impossible to determine precisely the degree of inclusiveness after 1904, because in the subsequent census years the Bureau adopted outright the federal bureau's figures for Massachusetts; but the percentage appears to have risen decisively, perhaps to 95 per cent or even higher.

[3] Compare U. S. Census of Manufactures, 1914, *Abstract*, pp. 29–56, and the *Annual Report* of the Massachusetts Bureau, 1914, p. 52.

cotton manufacture, the most important of all, is wholly dependent upon agriculture for its raw material. This is another disadvantage, because an especially large or an especially small cotton crop seriously affects the response of this industry (and therefore the aggregates for Massachusetts) to the business cycle.[1]

Another objection to the Massachusetts data lies in their discontinuity during the past sixteen years. Prior to 1906 the data published yearly covered identical establishments over a period of twenty-four months, so that the actual degree of change in these establishments between each December and the following January could readily be ascertained. This policy of "overlapping" the yearly reports was not maintained after 1906, and consequently the problem of building up a reliable continuous series is not an easy one. After 1906 the data do not form a true statistical series at all, but a series of floating fragments, unconnected with each other. As a local census of manufactures, year by year, these Massachusetts data are excellent; but as a continuous record of employment fluctuation they cannot safely be accepted without reservations.

Employment data for New Jersey.—From 1895 through 1918, the New Jersey Bureau of Industrial Statistics collected data very similar to the Massachusetts data, publishing them in its *Annual Reports*.[2] The scope of the materials, limited to about 50,000 wage-earners in 1895–97, was considerably enlarged in subsequent years, ranging from 140,000 in 1898 to 320,000 in 1914.[3] Here as in Massachusetts the canvass did not cover a fixed proportion of establishments, nor even a steadily increasing proportion. Thus, in 1899 an average of 175,000 wage-earners was represented, *i. e.*, 82 per cent of the number shown by the federal census of manufactures; the ratio fell to 77 per cent in 1904, then rose to 87 per cent in 1909, and 88 per cent in 1914. New Jersey, unlike Massachusetts, is industrially diversified: the machinery and metal-working industries are fairly strong, as is natural in a state situated so near to iron and coal resources; but silk, wool, tobacco, and several others also rank comparatively high. It is noteworthy that cotton ranks eleventh, representing only about 2 per cent of all New Jersey's manufacturing.

[1] Another disadvantage is the importance of women workers in the industries of Massachusetts—about 40 per cent in cotton goods, 32 per cent in boots and shoes and in woolen and worsted goods, and 25 per cent in paper manufacture. The employment of juveniles, to the extent of about one eighth of the grand total, also makes the returns less reliable than if they related solely to adult male bread-winners.

[2] The data for the years 1895–1916 were obtained from these reports. Those for 1917 and 1918 were made available through the courtesy of Mr. J. A. T. Gribbin of the Bureau. The series was discontinued in 1918, though of course the federal census will presently show 1919 data for New Jersey.

[3] The number rose rapidly during the war to a half-million and more, owing chiefly to the growth in the manufacture of munitions, explosives, and chemicals in that state.

Census data on employment.—Monthly figures of a nature similar to the two sets just described are available also for the United States as a whole, but only for the quinquennial census years. Despite their disconnected character they have seemed worthy of analysis, since they cover 5,000,000 to 9,000,000 workers and offer promise as supporting evidence. The first monthly data available from this source were collected in 1899, but unlike the subsequent censuses this first set included hand trades and neighborhood industries, and have never been corrected on a basis comparable with the others.[1]

The essential homogeneity of the census data after the 1899 Census may be seen in the figures showing industrial composition.[2] The most important industrial group in the country as a whole is the combination of textiles and their products, which form about 21 per cent of the total, as measured by the number of wage-earners. The second in order of rank among the fourteen standard groups is iron and steel, which alone forms about one sixth of the aggregate and when combined with the three kindred groups—railroad repair shops, vehicles for land transportation, and metals and metal products other than iron and steel—forms a quota considerably more than one fourth. Lumber comprises about one eighth, and several other groups—namely, food and kindred products, paper and printing, and stone, clay, and glass products—4 to 7 per cent each. Each of these industries has maintained its quota in a fairly stable manner throughout the period 1899–1914. In not more than two or three cases (vehicles for land transportation, railroad repair shops, and the miscellaneous group) has there been any appreciable increase, while in only two cases (lumber and its products, and leather and its products) has there been a decline. In all the other groups, quotas have remained practically constant.[3] The industrial distribution has clearly remained sufficiently stable from census to census to justify regarding the data as industrially homogeneous.

PRELIMINARY ANALYSIS OF EMPLOYMENT DATA

In the first method of analyzing these three groups of employment data, no assumption whatever was made as to the change between years; the data were regarded as reliably measuring only the course of developments *within* a calendar year. The effects of seasonal variation and of secular trend were eliminated as well as possible by a special method, in such a way as to show the status of the employment cycle

[1] See the *Abstract of Manufactures*, 1914, p. 435. Although the Census Bureau appears to have revised its "representative date" figures to exclude these extraneous industries, the monthly data have never been so re-worked. It is understood that the Bureau, under the direction of Dr. Leo Wolman, is now planning to make such a re-computation.

[2] *Abstract of Manufactures*, 1914, p. 29.

[3] No data on the industrial distribution at the census of 1919 are yet available.

in any month as compared with January of the current year. This method involved four steps, the first two of which are suggested by Persons' analysis of seasonal variation in *continuous* series. The procedure involved: (1) computing the month-to-month link relatives, except, of course, for $(\frac{\text{January}}{\text{December}})$; (2) taking the median of all the $(\frac{\text{February}}{\text{January}})$ links as indicating the normal combined influence of seasonal variation and secular trend between January and February, and correspondingly the median for $(\frac{\text{March}}{\text{February}})$, etc.; (3) subtracting from each actual link relative the corresponding median, yielding a percentage which should indicate the net effect of the business cycle between the two months; (4) finally, compounding the links into chain relatives with January of the current year as 100 per cent.

This method was first applied to the Massachusetts and the New Jersey data, yielding a series of fragments, one for each year. As an experiment, the method was also applied tentatively to the census data, though without great hope of success, because the sets of link relatives available for determining the normal month-to-month movements numbered only three. The 1919 data had not become available, and, as already explained, those for 1899 were not comparable; only those for 1904, 1909, and 1919 were available for use.

The need of relying upon three link relatives for determining the median did not result in such great inaccuracy as had been expected. In order to show the probable reliability of this rough method, experiments were made with the median link relatives, based first upon the eleven years 1903–13 and then upon the three census years for comparison. These sets of *median* link relatives were then joined together with January as 100. An illustration of the result is shown in Chart 1; the curves represent the normal effects of seasonal variation combined with secular trend on the New Jersey data. These experiments indicated that the median of three links is not hopelessly inaccurate; indeed it appears to be fairly reliable as a first approximation to the normal movements within the year. Accordingly, this method was applied to the census data for all states and all industries combined, and the resulting fragments compared with those derived from the state data for New Jersey and Massachusetts. Chart 2 shows these results for the census years.[1]

After the elimination of trend and seasonal variation, the cyclical elements present in the three sets of employment data are found strikingly similar. In amplitude, as in form, the three indexes agree

[1] The recently tabulated data for 1919 have just been placed in the writer's hands through the courtesy of Dr. Joseph A. Hill, Assistant Director of the Census.

CHART 1
GENERAL EFFECT OF SEASONAL VARIATION AND LONG-TIME TREND COMBINED, ON EMPLOYMENT IN NEW JERSEY
(JANUARY = 100 PERCENT)
Based on 3 sets of link relatives
Based on 11 sets of link relatives

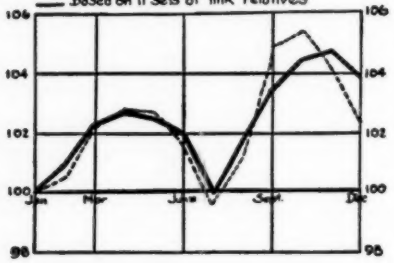


CHART 2
FRAGMENTS OF EMPLOYMENT CYCLES DURING CENSUS YEARS
(JANUARY OF CURRENT YEAR = 100 percent)
U.S. Census of Manufactures — Massachusetts Bureau
..... New Jersey Bureau

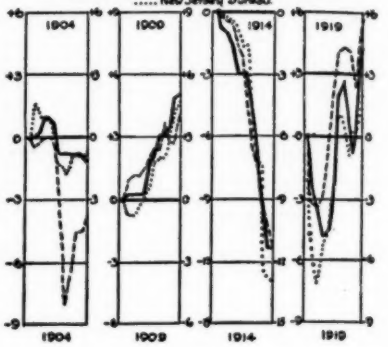
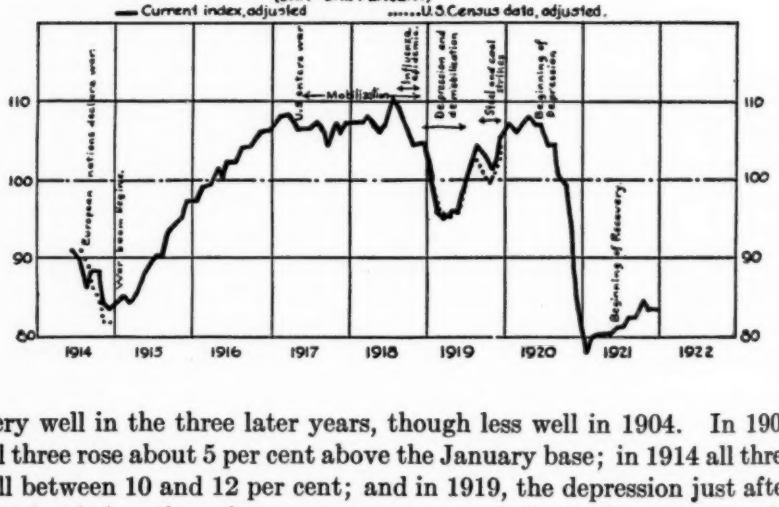


CHART 3
CURRENT EMPLOYMENT INDEX COMPARED WITH UNITED STATES CENSUS DATA
(UNIT: ONE PERCENT)
Current index, adjusted
.....U.S. Census data, adjusted.



very well in the three later years, though less well in 1904. In 1909 all three rose about 5 per cent above the January base; in 1914 all three fell between 10 and 12 per cent; and in 1919, the depression just after the Armistice, the subsequent recovery, and, in the last quarter, the steel and coal strikes, appear unmistakably in all three curves.

The erratic behavior of the employment indexes in 1904 is not a feature peculiar to themselves, but is found also in other industrial barometers, such as pig iron production. Study of the various trade papers in 1904 also indicates clearly that after the "rich men's panic" of 1903 two recoveries occurred in succession. The first, an abortive one, took place in the first half of the year, and was followed by a distinct slump. Then came the much more substantial recovery, be-

ginning late in 1904 and continuing for two years or more. This reflex action seems to stand unparalleled in the annals of American business. It is not unnatural that some dissimilarities of behavior should appear in a year characterized by such reversals of the industrial machine. The three indexes differ chiefly in their verdict as to the severity of the intervening relapse. Apparently it was felt more severely and was followed by a slower recovery in Massachusetts than in either New Jersey or the United States as a whole.[1]

The new 1919 Census returns enable us to check up the corrected post-war index presented in the March JOURNAL.[2] The current index covers only about 1¼ millions, the census 9 millions of wage-earners; but the two when corrected for seasonal variation show a correlation of 97 per cent. The curves in Chart 3, as in the one representing pre-war results, manifest a strong similarity in both form and amplitude. This evidence goes far to support the current index as a trustworthy barometer of current industrial employment.

FORMATION OF CONTINUOUS EMPLOYMENT INDEXES

The strikingly clear and decisive form of these cyclical fragments naturally raises the question whether any hypothesis can be applied which will make possible some form of adjustment that will enable one to join the fragments together in a continuous record of employment cycles in Massachusetts and New Jersey. Of the several hypotheses which have been tested, the best involves: (1) adoption of the data of the United States Census of Manufactures for Massachusetts and for New Jersey, as "abutments" upon which to adjust the respective state bureaus' data; (2) complete reliance upon the state bureaus' data as to the percentage changes in employment during each intercensal calendar year; and (3) the adoption of a standard or normal link relative to connect each December to the following January, on the assumption that the business cycle could be considered momentarily inoperative. The entire twelve-item fragment for each intercensal year was "stepped up" by such a percentage as to establish between each December and the following January this standard relationship.[3] Having

[1] The same method of analysis, applied to the census data for the dozen leading industrial states separately, shows that none was affected as was Massachusetts.

[2] First proposed by the writer in the *Special Letter* of Oct. 8, 1821, Harvard Economic Service.

[3] Two kinds of standard $\left(\frac{\text{January}}{\text{December}}\right)$ link relatives were utilized: (a) such a percentage as would precisely account for the residual fluctuation between consecutive census years, not accounted for by the course of the state bureaus' data *within* the intercensal years; also (b) the median of the known $\left(\frac{\text{January}}{\text{December}}\right)$ links for the period 1889–1906. The first of these is to be preferred, owing to changes in the degree of inclusiveness and in the slope of trend of the latter. Either method may lead to inaccuracy in determining any single transition between years, but on the average its results are not likely

thus interpolated the probable course of actual employment fluctuation between census years in these two states, the long-time trend, seasonal variation, and standard deviation were eliminated by an adaptation of the method devised by Professor Warren M. Persons,[1] yielding corrected cycles.

This method was applied to the Massachusetts data, first for cotton, then for all industries except cotton; the two resulting sets of cycles were combined on the basis of the relative importance of cotton manufacturing *in the entire country*. The same method was applied to all industries combined in New Jersey. Both curves are shown in Chart 4. Though derived wholly independently of each other, the results show a close correspondence; the correlation coefficient is 82 per cent. The only discrepancies are found in the abnormal year 1904, already discussed, and in such years as 1912 and 1913, when labor disputes in one state or the other caused temporary relapses.[2] In 1910 employment in Massachusetts was influenced both by labor disputes and by a short crop of cotton in the preceding year. With these minor exceptions, every important movement appears with almost equal clearness in the two indexes: the minor boom preceding the "rich men's panic" of 1903; the depression of 1904; the recovery and boom in 1905 and 1906; the relapse begun in July, 1907, and greatly accentuated by the panic of October–November; the beginning of recovery in June, 1908; the appearance and disappearance of the minor depression in 1910–11; the recovery in 1911–12; and the incipient depression of early 1913, continuing until after the outbreak of the war.[3]

---

to be greatly in error; moreover, the use of the standard deviation (after Persons) lessens still further the chance of error in the final cycles.

In the view of the present writer such a method seems far superior to the use of external evidence for combining these fragments. It is possible but undesirable to resort to other data. In the first place, no continuous data actually measuring employment were available before the war, and it is hazardous to translate absolute changes in the continuous unemployment data into employment. Even if this be done in a reliable manner, it introduces a spurious similarity between the adjusted series and the reference series. Any comparison among the results would, in short, be fallacious, *i. e.*, it would involve reasoning in a circle. The same objection of course holds against the use of production data or other business indexes in lieu of employment as the basis for estimating December-to-January changes in employment.

For a different view of this whole matter, see Ralph G. Hurlin, "Three Decades of Employment Fluctuation," *The Annalist*, vol. 18, pp. 387–88, October 24, 1921.

[1] For Persons' explanation of his method, see *Rev. of Econ. Statis.*, prel. vol. 1, pp. 4–205, Jan. and Apr., 1919. The slight change made by the writer in the seasonal analysis was the use of an arithmetic rather than a geometric law for eliminating the secondary effect of trend from the seasonal chain relatives. The straight-line law simplifies the computation, and is also more in harmony with the general principle of using a straight line in measuring the long-time trend itself—a principle which Persons himself utilizes in that connection.

[2] Especially the great silk strike in Paterson, N. J., February–July, 1913.

[3] The end of depression in the winter of 1914–15 also appeared simultaneously in the two states. *Cf.* this JOURNAL, vol. XVIII, pp. 45, 50, Mar., 1922.

MEASURES OF UNEMPLOYMENT

Even more valuable evidence as to employment fluctuations can be obtained by examining the fluctuations in unemployment, "the other side of the shield." Before the war two unemployment series were available, one for Massachusetts and one for New York state. Each was reported in consistent form, without sudden changes from year to year as in the pay-roll data; consequently they had in common the important advantage of continuity. They are also broader in industrial scope, comprising not only manufacturing but also building, transportation, etc. Both of the unemployment series are valuable, but that for New York has a net advantage, being reported monthly rather than quarterly, extending over a pre-war period twice as long as that for Massachusetts, and covering a much more important and more favorably situated industrial state.[1]

It is of course impossible to utilize these figures in their original form,[2] owing especially to the effects of labor disputes, seasonal variation, and long-time trend, as well as the very important changes in industrial composition. Suitable analysis has eliminated these difficulties,[3] yielding the two unemployment indexes shown in Chart 5. The results are in close accord with each other, and with the adjusted pay-roll data.[4] The correlation coefficients are as follows: between the two unemployment indexes, +72 per cent; between New York unemployment and New Jersey employment, −73 per cent; between New York unemployment and Massachusetts employment, −80 per cent; between Massachusetts employment and unemployment, −88 per cent.

A GENERAL INDEX OF EMPLOYMENT AND UNEMPLOYMENT

We now have before us all the materials necessary for constructing a general index of employment cycles for the United States. The three states represented in Charts 4 and 5 comprise more than one fourth of all the industrial wage-earners in the United States.[5] The indexes appear to represent adequately the course of employment in the respective states. Although constructed entirely without reference

[1] This JOURNAL, vol. XVIII, pp. 43–44.

[2] Compare Chart 4 with the charts of original items for these two series, shown by E. S. Bradford, "Methods Used in Measuring Unemployment," Quar. Pub. of the Amer. Stat. Ass'n, vol. XVII, pp. 991–93, Dec., 1921.

[3] The methods of analysis are fully described in *Rev. of Econ. Statis.*, prel. vol. 4, pp. 26–34, Jan., 1922.

[4] The discrepancy in 1904 is due to the facts already pointed out. The slightly earlier increase of unemployment in New York in 1907 is also attributable to business conditions, not to any peculiarity in the unemployment curve as such. Bank clearings in cities of New York state outside the metropolis follow in 1907 the same course as the inverted unemployment curve.

[5] New York, 15 per cent; Massachusetts, 8; and New Jersey, 5; a total of 28 per cent.

CHART 4
EMPLOYMENT IN MASSACHUSETTS AND NEW JERSEY
(MONTHLY CYCLES: UNIT ONE STANDARD DEVIATION)

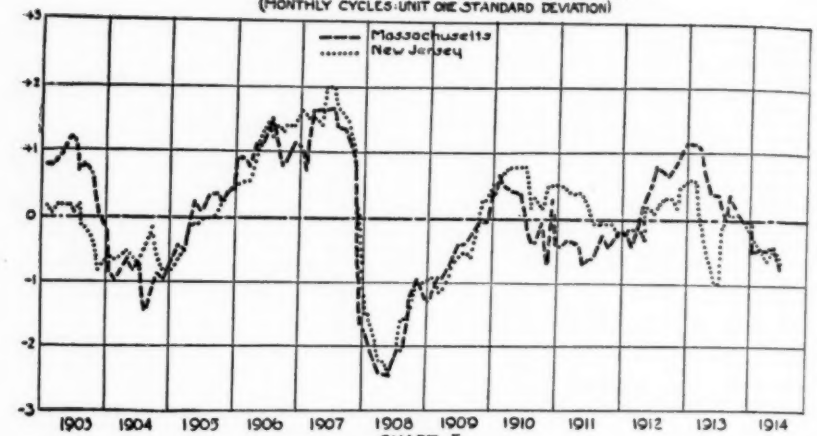


CHART 5
UNEMPLOYMENT IN NEW YORK STATE AND MASSACHUSETTS
(UNIT : ONE STANDARD DEVIATION)

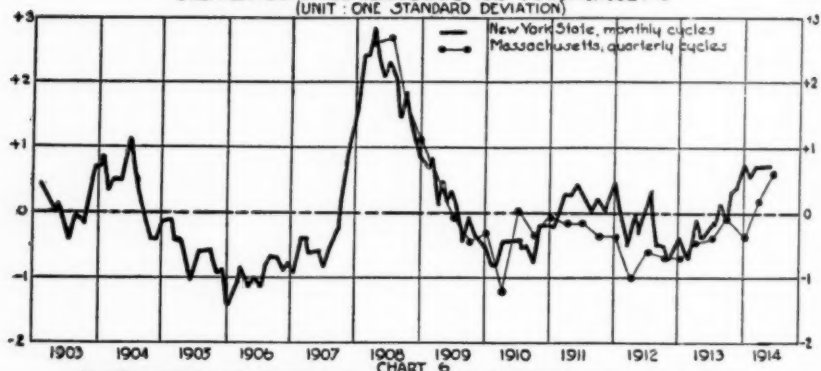
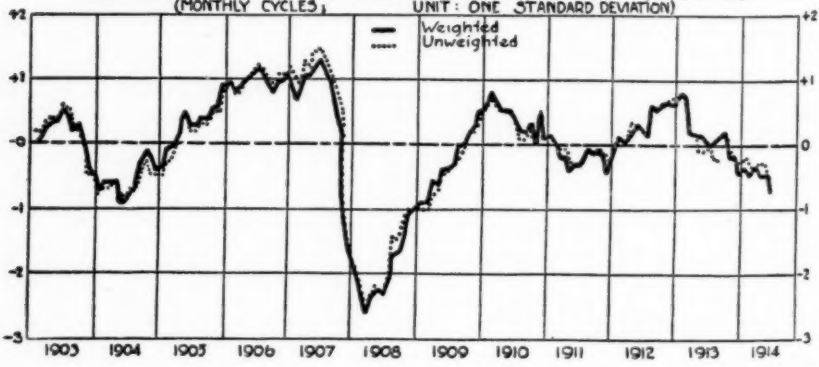


CHART 6
TWO COMBINATIONS OF EMPLOYMENT AND INVERTED UNEMPLOYMENT (3 STATES)
(MONTHLY CYCLES); UNIT : ONE STANDARD DEVIATION)



to one another, they support one another so thoroughly as to justify beyond any reasonable doubt a combination of the three.

Two such combinations[1] are presented in Chart 6. Both are based upon the two employment indexes and the New York unemployment index; the Massachusetts unemployment index, being quarterly, could not well be utilized in a monthly composite. In the weighted index the three components are assigned weights of five points (New York), three points (Massachusetts), and two points (New Jersey), proportional to the actual industrial importance of the three states, without penalizing the New Jersey and the Massachusetts data for their statistical and economic imperfections. If these be considered serious enough to justify reducing the two minor weights further, the combination would of course more closely resemble the inverse of the New York curve shown in Chart 5. Indeed, the reader who prefers to follow a strictly conservative policy may prefer to rely on the inverted New York index alone.[2] The question of weighting is, however, of slight importance in this case, owing to the similarity of the components. As a test of this, a simple average of the three has been constructed; this practically coincides with the 5–3–2 combination, as shown in Chart 6, giving a correlation coefficient of 99 per cent. The correlation between the unweighted combination and New York unemployment (inverted) is 94 per cent.

The continuous index of employment is strongly confirmed by the United States Census of Manufactures, before as well as since the war. Except in the industrially disordered year of 1904, the correlation coefficients have been consistently above 90 per cent—in 1909, 94 per cent, and in 1914, over 99 per cent. The post-war index has already been shown to have a correlation of 97 per cent. with the 1919 census.[3]

EMPLOYMENT AS AN INDEX OF INDUSTRIAL ACTIVITY; OTHER USES

Chart 7 shows an annual index, likewise constructed by weighting the New York, Massachusetts, and New Jersey data, on the 5–3–2 basis.[4]

[1] An earlier index has also been prepared, but it is omitted. It extends back to 1889, being based on the Massachusetts data alone until 1895, and on Massachusetts and New Jersey data between 1895 and 1902.

[2] See, for example, the *Rev. of Econ. Statis.*, prel. vol. 4, pp. 33–39, Jan., 1922. The weighted combination is presented in the table accompanying this article.

[3] *Supra*, p. 233. For the 1914 correlation the pre-war index was extended from June through December.

[4] Here the Massachusetts component for the years 1908–13 was obtained by taking the average of the employment and the reversed unemployment figures. To center the average of the quarterly unemployment cycles in the middle of the calendar year, a five-quarter rather than a four-quarter average was used: Dec. 31 of the previous year, and Jan. 31, Mar. 31, Sept. 30, and Dec. 31 of the current year.

The New York unemployment data are based upon the reports of all the unions in the state, rather than the representative selection (one-fourth to one-third as great) embodied in the monthly data. See *Rev. of Econ. Statis.*, prel. vol. 4, pp. 23, 24, Jan., 1922.

The curve is extended back to 1899, and is shown for comparison with Day's production index for all manufacture.[1] The correlation is extraordinarily close, being represented by a coefficient of 86 per cent.

CHART 7
INDUSTRIAL EMPLOYMENT AND PRODUCTION
(ANNUAL CYCLES; UNIT ONE STANDARD DEVIATION)

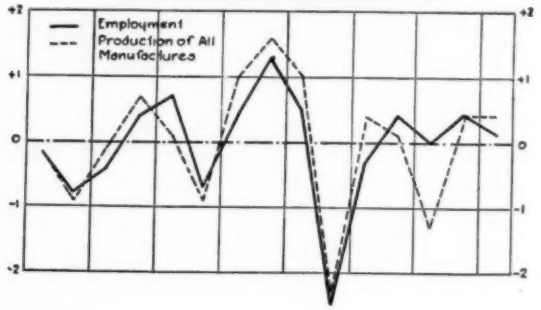
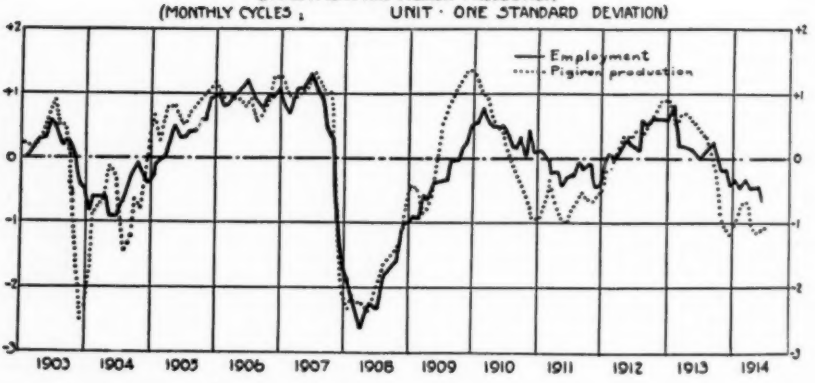


CHART 8
EMPLOYMENT AND PIGIRON PRODUCTION
(MONTHLY CYCLES; UNIT · ONE STANDARD DEVIATION)



This agreement, close despite the differences in the source and the nature of the two groups of data, suggests the possibility of utilizing employment as an index of monthly production cycles prior to the war. Chart 8 shows the monthly index of employment, compared with pig iron production.[2] Here, again, the agreement is very close (89 per cent). In monthly form very few production series other than that for pig iron were available prior to the war, so that employment provides a much more comprehensive basis for picturing the monthly

[1] Edmund E. Day, *An Index of the Physical Volume of Production*, pp. 62, 63.

[2] For the cycles of pig iron production see Warren M. Persons, "Indices of Business Conditions," *Rev. of Econ. Statis.*, prel. vol. I, pp. 104, 190–4, Jan. and Apr., 1919.

pre-war cycles of industrial production than can be obtained from direct evidence. The employment index covers not only a much wider variety of lines, but many more advanced stages of fabrication than could be represented in an index based on production data. Further substantiation is found in the relation of employment to other series representing the volume of activity, such as bank clearings outside New York City. There is conclusive evidence that employment affords a highly satisfactory index of industrial activity,[1] both before and since the war.

There are important differences in the *amplitudes* of indexes derived from the two sources, chiefly because of cyclical fluctuations in labor efficiency and in the volume of part-time and over-time employment.[2] But when inequalities of amplitude are eliminated by use of the standard deviation as a vertical unit, the *cycles* of activity appear practically the same, whether represented by employment or by production data.[2]

In conclusion attention should be called to other uses of the pre-war and the current indexes of employment. Properly analyzed, they have other economic uses than merely to afford a guide to cycles of productive activity. Employment cycles represent the course of the labor market. The employment manager can estimate the opportuneness of his labor policy by watching the course of employment, just as the financier can time his operations by following the fluctuations in the volume of loanable funds. When workers are already heavily employed we have a "tight" labor market; when employment is less full the labor market is "easy." In each case it is necessary, though not sufficient, to watch the course of prices or rates, i. e., wage-rates and money-rates; the available *volume* of labor and of capital should also be studied. On the commercial side also the employment cycle has economic significance. The writer has found that wage-rates normally lag nearly a year after employment in this country. That means that buying-power, a composite product of the volume of employment and wage-rates, also lags somewhat after employment. Employment forms a satisfactory first approximation to a barometer, or more strictly a forecaster, of pecuniary buying-power. The employment cycle is therefore of direct concern to the business man, whether he be interested chiefly in the labor market, in production, or in sales.

Not only the business man but also the social worker may find the study of the employment cycle of great practical value. Even though

[1] Described in the *Rev. of Econ. Statis.*, prel. vol. 4, pp. 35–39, Jan., 1922. This and other significant relationships of the employment index will be presented more fully in a forthcoming monograph of the Pollak Foundation.

[2] For further treatment of these points see *Rev. of Econ. Statis.*, prel. vol. 4, pp. 17–19, Jan., 1922.

from some points of view it might be desirable to know the number of the unemployed, one may obtain much light as to the seriousness of the social situation at a given time by learning from an index the *relative intensity* of unemployment as compared with that at various times in the past. As contrasted with the usual method of estimating the volume of unemployment, the index has the two-fold advantage that it is probably more reliable, and that it establishes a norm in past experience for judging and interpreting the current employment situation. Some unpublished studies by the present writer seem to demonstrate a clear causal relationship between the business cycle and some eight or ten indexes reflecting social welfare. Undoubtedly a key element in the linkage by which the forces of the business cycle impinge upon general well-being is employment.

GENERAL INDEXES OF EMPLOYMENT IN THE UNITED STATES

(Unit: one-tenth of one standard deviation)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						(A) Pre-war Index						
1903	0	+2	+3	+3	+4	+6	+4	+2	+3	0	+5	−5
1904	−8	−6	−6	−6	−9	−9	−7	−6	−3	−1	−3	−4
1905	−3	−1	0	+4	+5	+3	+3	+4	+4	+6	+6	+9
1906	+10	+8	+9	+10	+11	+12	+11	+9	+8	+10	+10	+11
1907	+8	+7	+11	+11	+12	+13	+11	+9	+6	+1	−8	−16
1908	−20	−22	−26	−23	−22	−23	−20	−17	−16	−11	−10	−10
1909	−9	−9	−6	−6	−4	−4	−3	0	0	+2	+3	+5
1910	+6	+8	+6	+5	+5	+4	+2	+2	+3	0	+4	+1
1911	+1	0	−2	−2	−4	−3	−3	−1	−2	−1	−2	−4
1912	−1	+1	0	+2	+3	+2	+1	+6	+5	+6	+6	+6
1913	+8	+8	+3	+2	+1	0	0	+1	+2	−2	−2	−4
1914	−4	−4	−5	−4	−5	−6	....	....	....	....	....	....
						(B) Current Index						
1914	....	....	....	....	....	....	−11	−14	−11	−11	−15	−17
1915	−16	−16	−16	−15	−13	−11	−11	−10	−7	−5	−4	−3
1916	−3	−2	−1	+1	0	+2	+2	+4	+5	+6	+7	+6
1917	+8	+7	+7	+5	+6	+6	+7	+6	+5	+7	+7	+8
1918	+7	+6	+7	+6	+6	+7	+10	+9	+8	+4	+5	+4
1919	0	−4	−5	−4	−4	−1	+2	+4	+3	+1	+2	+5
1920	+7	+6	+7	+8	+7	+7	+4	+5	+1	−1	−9	−16
1921	−22	−20	−20	−20	−20	−19	−19	−18	−18	−16	−17	−17
1922	−18	....	....	....	....	....	....	....	....	....	....	....

NOTES

THE FEDERAL RESERVE BOARD'S PRICE INDEX FOR GREAT BRITAIN

By Katharine Snodgrass

In the Quarterly for September, 1920, an article was published describing the Federal Reserve Board's index of American prices, the first of a series of international indexes which the Board proposed to construct for the study of the relationship of prices in different countries. Since that time the British index number has been added to the series, and in the course of the next six months it is hoped that Japanese, Canadian, and French numbers will be completed.

CLASSIFICATION OF COMMODITIES

The British number is of approximately the same size as the American, *i. e.*, 60 to 65 different commodities are included, many of them represented by several quotations, so that the total number of different quotations is between 90 and 100 in both cases. For the most part, the same commodities are included in both indexes. The British index, however, contains 10 commodities which are not in the American, while the latter contains 7 which are not in the British.[1] The method of construction and the classification of commodities is the same in both cases. All commodities have first been separated into domestic or home produced materials, and imported goods. Each of these groups has then been subdivided into (1) raw materials, (2) producers' goods, and (3) consumers' goods. In the case of the British index the following ratios show the importance of each of these groups to the total:

RATIO OF GROUP INDEXES TO TOTAL IN BRITISH INDEX

	Goods produced	Goods imported	Raw materials	Producers' goods	Consumers' goods	All
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Average, 1913...	73	27	40	30	30	100
June, 1921.....	77	23	40	27	33	100

[1] A list of the quotations used in the construction of the British index number with the sources from which the quotations were drawn may be found in the Federal Reserve Bulletin for February, 1922. A similar list for the American index is published on p. 500 of the Federal Reserve Bulletin for May, 1920. Revisions of this list may be found on p. 702 of the Bulletin for June, 1921, and p. 574, for May, 1922.

In the American index the ratios are very different for domestic and imported goods, and raw materials bear a higher ratio to manufactured goods than in the British index.

RATIO OF GROUP INDEXES TO TOTAL IN AMERICAN INDEX

	Goods produced	Goods imported	Raw materials	Producers' goods	Consumers' goods	All
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Average, 1913...	93	7	45	19	36	100
June, 1921.....	96	4	43	19	38	100

One additional group index has been constructed for both countries, namely, that of the prices of goods exported. As in the case of imports, this index is more important for England than for the United States, the British export index bearing a ratio of 20–25 per cent to goods produced, while in the case of the American index the ratio is normally somewhat under 10 per cent. This classification of the goods included in the indexes under domestic, imported, and exported is especially interesting at the present time because of the maladjustment between domestic and foreign prices which has come about as a result of the limitations which have been placed upon the use of gold in foreign exchange. The further classification according to stage of manufacture is useful as supplementary information in the study of prices according to groups of industries. Until this index was constructed there was no British index which contained classifications other than those along industrial lines. The old Board of Trade index gave the foreign trade classification, but its results were vitiated by the fact that customs values instead of market quotations were used.

METHOD OF CONSTRUCTION

Both the American and the British index numbers are of the weighted, arithmetic type. In other words, each index is based upon the aggregate money value represented by the quantity of the goods produced and imported in 1913 multiplied by their prices. These aggregates are expressed in terms of percentages of the 1913 base which is assumed to be normal.[1] Considerable difficulty was encountered in arriving at satisfactory production weights for the British index because no census has been taken since 1907. In several industries studies had been made during the war, which were useful; but in a few cases it was necessary to be satisfied with rather rough estimates. Export and

[1] For more detailed description of the method of construction used in the American index, see p. 326 of the Quar. Pub., of the Amer. Stat. Ass'n for September, 1920. The British index has been identically constructed.

import quantity weights were carefully adjusted by value figures so that there would be no over- or under-weighting in cases where price quotations of imports or exports were higher or lower than average. This type of adjustment could not be applied to the weighting of the "goods produced," however, because of inadequate data. In a few cases, such as the iron and steel industry, the weights were increased to give representation to commodities more highly manufactured than those in the index. The following table shows the importance of the several industries in the final index number for 1913:

IMPORTANCE OF THE SEVERAL INDUSTRIES IN BRITISH PRICE INDEX IN 1913

	Per cent
Grains	10
Meats	9
Other foods	11
Iron and steel	15
Coal and coke	17
Other minerals	3
Cotton	14
Wool	8
Other textiles	2
Miscellaneous	11
Total	100

PRICE QUOTATIONS

Considerable care was used both in the choice of the commodities included in the index and in the sources from which the quotations were taken. In general, it may be said that all of the leading British industries are represented in the index, some more satisfactorily than others, to be sure, but all to a certain degree. Probably the most serious omissions are woolen cloth, imported hides, and domestic leather. No quotations for woolen cloth are published and no manufacturers could be found who were willing to divulge their own quotations. There are also no satisfactory foreign hide or domestic leather prices available, partly because of the lack of any generally recognized standards for materials in the trade. Other lines which gave especial difficulty but for which quotations were finally obtained are raw wool, raw and finished tobacco, paper, and lumber. Reliable foreign wool prices are not published in any British trade paper in a form intelligible to the people who are not following the trade closely. After each auction, however, summaries of the prices which prevailed for the different grades of the commodity at the preceding auction are compiled by various wool brokers. This type of quotation has been used in the index and is probably as satisfactory a price as can be obtained for most commodities, except that the quotations are likely to be somewhat irregular. At the present time, however, auctions are held almost every month. Tobacco and lumber prices had to be obtained from private firms, since no satisfactory price-collecting agency seems to

exist in these industries. Prices could not be obtained for paper of any variety, and quotations for sulphate bleached were used to represent the industry.

Very satisfactory price-reporting services are conducted by the *British Board of Agriculture* for live stock and meat prices, by Bromhall's *Corn Trade News* for grains, the *Wool Record* for wool tops and yarns, the *Manchester Guardian* for cotton in all stages of manufacture, the *Iron and Coal Trades Review* for coal, the *Iron and Steel Trades Journal* for these and other metals, the *Chemical Trades Journal* for chemicals. Other periodicals which have been used are *The Grocer, Textile Mercury, Oil News, World's Paper Trade Review, Mark Lane Express Agricultural Journal, Leather World,* the *Statist,* and the

TABLE I

BRITISH INDEX NUMBER FOR THE POST-WAR PERIOD (1913=100)

	Goods produced	Goods imported	Goods exported	Raw materials	Producers' goods	Consumers' goods	All commodities
1919							
Jan.	221	244	242	210	238	241	227
Feb.	215	240	231	208	229	234	222
March	202	233	222	206	200	226	210
April	208	230	219	207	213	225	214
May	220	234	232	211	237	229	224
June	231	241	233	216	257	236	234
July	240	247	265	222	269	244	242
Aug.	250	246	278	234	277	243	249
Sept.	253	246	302	239	277	241	251
Oct.	262	259	332	250	288	249	261
Nov.	273	269	345	255	310	260	272
Dec.	283	280	399	261	331	267	287
1920							
Jan.	302	298	452	270	358	289	305
Feb.	316	314	478	281	392	291	320
March	327	319	483	287	406	300	329
April	332	324	486	292	409	306	334
May	341	322	484	306	406	310	340
June	344	306	469	308	396	311	339
July	330	299	452	307	363	302	326
Aug.	322	304	439	307	352	297	322
Sept.	319	288	421	301	341	296	315
Oct.	301	272	392	290	309	282	297
Nov.	285	253	369	282	278	267	280
Dec.	266	230	328	265	244	255	260
1921							
Jan.	252	207	246	233	231	261	244
Feb.	234	190	201	213	213	246	226
March	219	182	189	202	198	231	213
April	211	180	185	201	184	225	206
May	209	167	182	198	179	216	201
June	206	161	179	196	173	213	197
July	204	164	174	192	165	222	196
Aug.	202	165	168	193	161	223	195
Sept.	199	170	171	195	165	212	194
Oct.	192	163	175	187	166	200	187
Nov.	182	154	164	177	153	191	177
Dec.	176	152	158	173	147	186	172
1922							
Jan.	174	149	158	171	147	181	170
Feb.	171	148	151	168	144	181	167
March	172	147	153	170	142	183	168
April	171	148	152	167	143	183	167

Economist, the latter two only when no trade journal could be found which quoted prices. In the American price work it had been found that unless a large amount of money could be spent, it was preferable to use reliable trade publications as a source for quotations rather than private firms. The same is true of the British situation. It is only in the case of a few highly manufactured commodities such as shoes that quotations of private firms have been used.

THE INDEX NUMBERS

Neither the British index nor the American index was constructed for the war period. The indexes cover 1913 (which is used as the base period), 1919, 1920, and 1921 and are being constructed currently each month. The table preceding contains the British index numbers for the post-war period expressed in their ratio to the base period (1913). This number for all commodities agrees very closely with the new index of the British Board of Trade which was first published in the spring of 1921. The latter index has not been constructed for 1919, but during 1920 and 1921 there was a high degree of similarity in the movement of the two index numbers. The correlation of the Federal Reserve Board index with the *Economist* and the *Statist* indexes is not so great, although there is not a wide divergence between them. The Board of Trade index is based upon something over 150 price quotations, is roughly weighted, and is a geometric average; the *Economist* and the *Statist* indexes are only about a third as large as the Board of Trade index, are based mainly upon the prices of raw materials and semi-finished goods, are weighted only by the number of quotations assigned to each commodity, and are averaged arithmetically.

In a period of rapid price change like the one since the war it would be presumptuous to claim infallibility for any price index. For instance, if a weighted geometric instead of a weighted arithmetic average had been used in the construction of the Federal Reserve Board index in the months from January, 1920, to June, 1921, the level of British prices would have worked out 5 to 10 per cent lower than it does on the arithmetic basis. The greatest difference between the arithmetic and the geometric averages occurs when there is a wide deviation from the average in the prices of important commodities. During the period of highest prices in the spring of 1920, the dispersion of quotations for leading commodities was so wide that it is impossible to choose the point of greatest concentration. During this same period there was a relatively high degree of concentration of the prices of the less important commodities, but these combined had little influence in determining the final average. As the price level in England declined, the

dispersion of individual prices also diminished, and as a result the geometric and the arithmetic averages came into closer harmony. Although no definite experiments have been made, it cannot be doubted that a change in the period upon which the "weights" are based would make similar differences in the final index number, as would the addition or the elimination of an important commodity from the index.

In the following table the all-commodities indexes of these four agencies are compared:

TABLE II

ALL COMMODITIES WHOLESALE PRICE INDEX NUMBERS FOR ENGLAND
(1913=100)

	Federal Reserve Board	Board of Trade	Statist	Economist
1919				
Jan.	227	...	224	217
Feb.	222	...	220	215
March	210	...	217	212
April	214	...	217	214
May	224	...	229	222
June	234	...	235	230
July	242	...	243	239
Aug.	249	...	250	241
Sept.	251	...	252	245
Oct.	261	...	264	252
Nov.	272	...	271	259
Dec.	287	...	276	273
1920				
Jan.	305	303	288	288
Feb.	320	317	306	303
March	329	326	307	310
April	334	332	313	306
May	340	333	305	304
June	339	330	300	291
July	326	324	299	292
Aug.	322	320	298	287
Sept.	315	318	292	284
Oct.	297	309	282	266
Nov.	280	293	263	245
Dec.	260	269	243	220
1921				
Jan.	244	251	232	209
Feb.	226	230	215	192
March	213	215	208	189
April	206	209	199	183
May	201	206	191	182
June	197	202	183	179
July	196	198	186	178
Aug.	195	194	181	179
Sept.	194	191	175	183
Oct.	187	184	163	170
Nov.	177	176	161	165
Dec.	172	171	157	162
1922				
Jan.	170	167	156	159
Feb.	167	...	155	158
March	168	165	157	160
April	167	163	158	...

VALUE OF THE WORK

In 1919, when work was commenced on this series of international price indexes, there was the greatest dissimilarity among the numbers

in current use in the various countries. In the United States the index of the Department of Labor was generally recognized as the best, but it was based upon about 325 price quotations while most of the foreign indexes consisted of no more than 50 or 60. It seemed essential, therefore, as a prerequisite to accurate studies of price trends or price levels in different countries, to have a series of comparable or at least representative index numbers. In the course of the two years since that time a great deal of price work has been done in foreign countries, so that the situation is altered in important respects. In England the Board of Trade has revised and enlarged its index. The same is true of the Bachi index for Italy, while in Germany the *Frankfurter Zeitung* has constructed a new fairly large one. It is now possible, therefore, to make fairly accurate comparisons of wholesale prices in general in these countries, both on a paper and on a gold currency basis. The greatest value in the work of the Federal Reserve Board is that it concentrates within one organization an unusually comprehensive body of comparable international price material and that this material is handled in a similar fashion in the construction of its various index numbers. In addition, new classifications of commodities have been made which bring out interesting facts for the student of international price relationships. It also appears to be fairly well established, in view of the similarity between the Board of Trade and the Federal Reserve Board indexes for England, and between the Department of Labor and the Federal Reserve Board indexes for the United States, that very satisfactory wholesale price indexes can be constructed on the basis of less than 100 quotations.

MONTHLY PRODUCTION OF PIG IRON, 1884 TO 1903

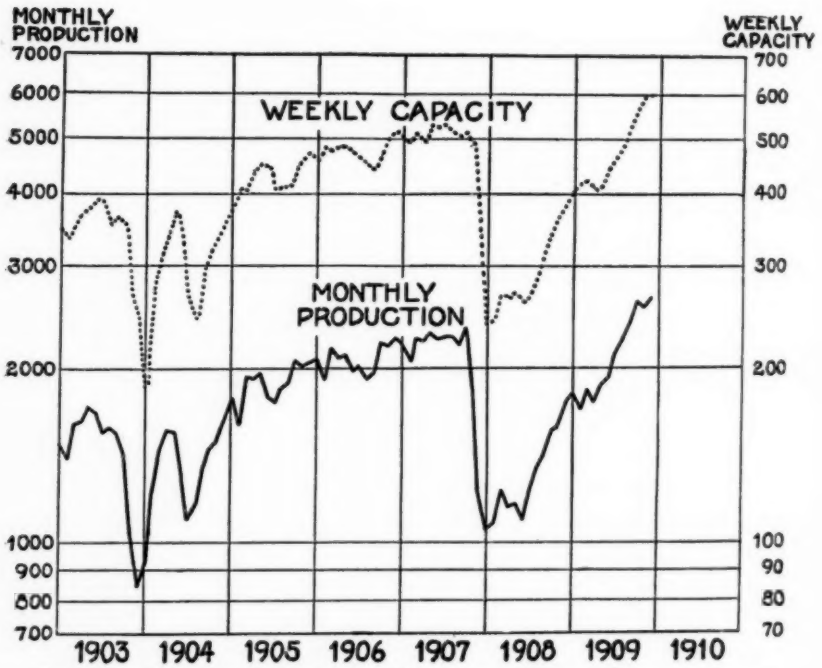
By Margaret G. Myers

Production of pig iron is perhaps the best single index which we have of the volume of industrial activity in the United States. Its fluctuations agree closely with a number of composite indexes of business and industrial activity which have been made up from time to time, and they also tend to move with such records of general business activity as employment, bank clearings, and freight traffic. For this reason the fluctuations are of unusual interest. Annual figures on pig iron production are available practically continuously as far back as 1846. Monthly figures, however, were not collected until 1903, when the *Iron Age* began a compilation for the different kinds of pig iron.

Prior to 1903 there had been published by the *Iron Age* for each month as far back as 1884 figures for the number of furnaces in and out of blast, and the weekly capacity of furnaces in and out of blast at the first of each month. Although the figures for the number of furnaces do not furnish a true indication of the amount of production, the figures for weekly capacity of furnaces in blast run very close to production figures. For the years from 1903 to 1909 reports are available both for weekly capacity of furnaces in blast and for the monthly production of pig iron. The two series are shown in the accompanying diagram.

The close correspondence of the fluctuations of the two lines indicates the possibility of predicting production from the weekly capacity in blast. The coefficient of correlation between the two series is +.975. In computing this coefficient no allowance has been made for secular trend because the particular period under review does not show such a trend in marked degree.

From the figures for the years 1903 to 1909 a regression equation



REPORTED WEEKLY CAPACITY OF FURNACES IN BLAST COMPARED WITH PRODUCTION OF PIG IRON EACH MONTH

(Figures in thousands of tons)

was computed to obtain the relation between production and weekly capacity in blast. The resulting formula was $x=8.1+4.34y$, in which x = production and y = weekly capacity in blast, and the figures are in round thousands of tons. By the use of this formula production figures have been computed for each month from 1884 to 1902. The resulting figures are shown in the following table. They were reproduced in graphic form in the *Monthly Review of Credit Conditions*, of the Federal Reserve Bank of New York, for March 1, 1922, together with the figures for succeeding years which have been published currently in the *Iron Age*.

MONTHLY PRODUCTION OF PIG IRON COMPUTED FROM THE WEEKLY CAPACITY OF FURNACES IN BLAST AT THE FIRST OF EACH MONTH

(In thousands of long tons)

	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893
Jan.	329	260	373	503	533	624	711	681	776	724
Feb.	...	282	377	534	459	606	713	594	772	711
March	...	312	377	542	429	611	737	546	798	737
April	...	299	433	551	446	607	736	460	768	746
May	342	299	468	559	472	590	742	468	737	759
June	325	290	481	395	476	555	737	603	711	729
July	334	286	477	433	451	577	716	703	698	642
Aug.	312	290	468	442	477	577	676	698	646	446
Sept.	294	282	451	533	507	585	698	698	624	347
Oct.	286	286	472	568	525	611	729	737	655	303
Nov.	294	303	481	572	564	672	724	772	711	334
Dec.	299	342	490	564	601	685	707	781	733	416

	1894	1895	1896	1897	1898	1899	1900	1901	1902
Jan.	420	720	885	676	967	1037	1254	1063	1275
Feb.	425	694	841	694	980	1019	1267	1215	1419
March	468	672	807	724	1002	980	1249	1245	1380
April	542	676	798	737	998	1054	1232	1262	1445
May	468	668	811	733	998	1071	1254	1284	1475
June	264	672	776	724	959	1089	1262	1340	1471
July	364	733	763	707	924	1122	1202	1327	1505
Aug.	494	772	663	707	876	1141	1032	1297	1436
Sept.	637	833	542	794	906	1145	980	1280	1432
Oct.	642	863	468	854	920	1189	941	1314	1475
Nov.	694	928	525	915	976	1228	906	1371	1440
Dec.	720	928	603	967	1006	1262	972	1384	1471

The yearly totals of the monthly production figures computed by this means are not far different from annual production figures published by the *Iron Age*, and there is no noticeable tendency toward a greater or less difference as computations are carried back into earlier years.

THE RATIO OF MALE TO FEMALE BIRTHS AS AFFECTED BY WARS

By E. R. Shaw

The theory has been advanced that the proportion of male to female births rises during or just after a period of war or similar catastrophe in which the mortality of the males has been unusually heavy, as though nature strove to keep the proportion of the sexes roughly at a constant figure. Düsing, in supporting his contention that late fertilization of females and increased time intervals between fertilizations tend to result in a relatively large number of males, says: "In fact, we note that after every war there is a relative over-abundance of male births. After the Napoleonic Wars this phenomenon was so strongly apparent that people feared a relative shortage of females. This has long been well known, has been noted after every war, and has never been doubted."[1] F. Prinzing refers to this theory also in the *Medizinische Statistik* (1906), where he writes: "After wars the relative number of males is said to be higher. Düsing calls it a well-known fact, and Von Fircks draws this conclusion from the German figures after 1866 and 1871."[2]

This same contention has been brought forward by later statisticians and scientists. In a recent presidential address before the Royal Statistical Society, Sir Bernard Mallet presented figures showing that the proportion of male births to female births in England and Wales, Scotland, and Ireland for the years 1915 and 1916 was above the proportion for the twenty years 1894 to 1913. He stated that for the whole period covered by these war births the proportion of male to female births in England and Wales was 1,046, or eight above the average for the previous forty years, and concluded that "a rise in the sex proportion so marked and sustained over so long a period can hardly be dismissed as an accidental coincidence."[3]

The British *Medical Journal* seems to put some faith in the theory, for it states (Nov. 21, 1914, p. 886) that it is remarkable that in 1857, the year after the return of our army from the Crimea, the excess of male over female births was much higher than the average for the three previous and the three subsequent years, and again immediately after the Boer War in 1901–02 it rose above the average for the preceding period, 1897–1900. So general is the interest in this matter

[1] C. Düsing, *Regulierung des Geschlechtsverhältnisses*, 1884, p. 19.
[2] *Ibid.*, p. 82.
[3] *Royal Statistical Society Journal*, Jan., 1918, pp. 14–15.

that one of our leading newspapers[1] mentions it and refers to the fact that a scientist of New York City maintains that the hard conditions imposed on women during war times seem to result in a preponderance of male births during and after wars. It also quotes Dr. Corrado Gini as saying that sex determination in a crude form has been exhibited in Italy since the war by a large increase in the number of male children.

A theory thus upheld by statisticians and scientists, and one which seems to have become traditional, offers a problem of considerable interest. The contention of this paper is that there is no conclusive evidence for the theory of an increased proportion of male over female births during or after wars.

The figures of male and female births after the Franco-Prussian War have been brought forth as upholding this theory. Table I[2] gives the ratios for living births in France.

TABLE I

Year	Ratio[a]	Year	Ratio	Year	Ratio
1862	1,052	1867	1,042	1872	1,047
1863	1,049	1868	1,047	1873	1,050
1864	1,054	1869	1,050	1874	1,052
1865	1,051	1870	1,048	1875	1,051
1866	1,053	1871	1,048	1876	1,047

[a] In this and the following tables the ratios are the number of male births per 1,000 female births.

The average proportion for the pre-war years from 1862 to 1869 inclusive was 1,050, for the war years 1870 to 1872 it was 1,048, and for the post-war years 1873 to 1876, 1,050. Though the period after the war shows a greater proportion of male births than the war years, it is no greater than that of the years of peace before 1870.

An investigation of the figures for the German Empire from 1872 to 1880 gives the results shown in Table II.[3]

TABLE II

Year	Ratio	Year	Ratio	Year	Ratio
1872	1,053	1876	1,055	1880	1,054
1873	1,052	1877	1,051	1872–74	1,053
1874	1,054	1878	1,051	1875–80	1,054
1875	1,059	1879	1,053		

If any such effect as an increase of the proportion of male over female births had taken place it would be noticed in the years immediately following the war. For the first three years, 1872 to 1874, the ratio was 1,053. For the years 1875 to 1880 the average ratio was 1,054.

[1] *New York Times*, Jan. 22, 1922.
[2] *Annuaire Statistique de la France*. Vol. 1, p. 48.
[3] *Statistik des Deutches Reichs*. N. F. Vol. 44, p. 176 (living births only).

The Prussian figures from 1861 to 1880 are given in Table III.[1]

TABLE III

Year	Ratio	Year	Ratio	Year	Ratio
1861	1,049	1868	1,055	1875	1,060
1862	1,052	1869	1,055	1876	1,053
1863	1,047	1870	1,049	1877	1,054
1864	1,047	1871	1,052	1878	1,051
1865	1,052	1872	1,053	1879	1,052
1866	1,048	1873	1,052	1880	1,055
1867	1,049	1874	1,056		

These ratios do not show any consistent rise in the sex proportion of births just after the wars. In 1868–69 the ratio was six above the ratio for 1867; but in 1862 the ratio had increased above that for 1861, and in 1865 it was five above that for 1864. The years immediately succeeding the Austro-Prussian War of 1866 do not show increases greater than those in the preceding years of peace. With regard to the Franco-Prussian War, no increase in the proportion is noticed until 1874 and 1875, in which years the ratio rose to 1,056 and 1,060 respectively, falling again in 1878 to 1,051, and rising to 1,055 in the two years following. The changes in the proportion of male to female births do not come during or just after the war periods with any regularity, and it is hardly justifiable to cite these figures as upholding the theory under discussion. In a paper[2] delivered before the Royal Statistical Society Mr. Nixon presents monthly figures for Prussia which fail to record any effect of the war. The largest rise was from 1,043 in July, 1870, to 1,069 in the following month; but this ratio was exceeded both before and after the war. Thus, the proportions of male to female births in Prussia and Germany, just as in France, seem to have been unaffected by the Austro-Prussian and the Franco-Prussian wars.

The Japanese-Chinese War of 1894–95, lasting until about September, 1895, was hardly serious enough to have any effect upon the proportion of male to female births, even if we assume that wars in general do increase it. The proportion of male to 1,000 female births for these years in Japan is given in Table IV.[3]

TABLE IV

Year	Ratio	Year	Ratio	Year	Ratio
1893	1,040	1895	1,050	1897	1,054
1894	1,052	1896	1,033	1898	1,035

[1] *Statistique Internationale du Mouvement de la Population.* Vol. 1, p. 329 (living births only).
[2] *Royal Statistical Society Journal*, July, 1916, p. 435.
[3] *Résumé Statistique de L'Empire du Japon.* 1893–08.

It is seen that the ratio is higher in 1894 and 1895, falling in 1896, and rising in 1897. The increase after the war is irregular and offers no support to the theory advanced.

The Boer War of 1899–1902 did not affect the normal sex ratio of births. The proportion of male to female births in England and Wales remained practically stationary—between 1,032 and 1,038—from 1896 to 1900.[1] In 1901 it rose to 1,039, falling in 1902 to 1,027; and for the next five years it again fluctuated as before the war, between 1,032 and 1,037. The sex proportion of births for this period in Scotland is irregular, and no conclusions can be drawn from these figures.

The World War, because of its magnitude and duration, should, if any war does, have influenced the proportion of male to female births. Table V[2] gives the proportion of male to female births for certain of the warring countries as well as for some of the neutral ones.

TABLE V

Country	1919	1918	1917	1916	1915	1914	1913	1912	1911	1910
England and Wales[a]	1,060	1,048	1,044	1,049	1,040	1,035	1,038	1,040	1,039	1,040
Ireland	1,071	1,047	1,052	1,065	1,064	1,052	....	1,048	1,064	1,045
Scotland	1,064	1,045	1,054	1,056	1,047	1,033	1,041	1,051	1,045	1,037
Netherlands[b]	1,067	1,061	1,055	1,055	1,059	1,056	1,047	1,054	1,050	1,060
Germany[c]	....	....	....	....	....	1,056	1,054	1,059	1,055	1,053
Italy[d]	....	....	....	1,054	1,050	1,051	1,050	1,056	1,054	1,052
Denmark[e]	1,064	1,057	1,046	1,055	1,052	1,048	1,056	1,055	1,046	1,053
Switzerland[f]	1,044	1,055	1,043	1,057	1,043	1,061	1,051	1,055	1,040	1,051
Norway[g]	....	....	1,054	1,054	1,043	1,070	1,056	1,059	1,059	1,047

[a] *Annual Report of the Registrar-General*, England and Wales. 1919.
Annual Report of the Registrar-General, Ireland, for each year.
Annual Report of the Registrar-General, Scotland. 1919.
[b] *Annuaire Statistique*, Netherlands. 1919.
[c] *Annuaire Internationale de Statistique*. 1917.
[d] *Annuaire Statistique*, Italy. 1917–18.
[e] *Annuaire Statistique*, Denmark. 1920.
Reports of Births, Deaths, and Marriages, Denmark, 1911–15.
[f] *Annuaire Statistique*, Switzerland. 1920.
[g] *Annuaire Statistique*, Norway. 1920.

In England and Wales the ratio was 1,039 for the four years preceding the war; during the war years it averaged 1,043, and in 1919 rose to 1,060, falling in 1920[3] to 1,052. Although in Ireland the highest ratio came in 1919 it fell in 1920, during which year it was less than it had been in two of the war years. The same general trend holds true for Scotland. The figures for Germany show a rise in 1916–17, but no change in the years immediately preceding. As far as the Italian figures go, no change in the proportion of sexes at birth is noticed during the war years. The Netherlands have an average of 1,053 for the

[1] See the reports of the Commissioner of England, Scotland, and Wales. Vol. 14, 1914.
[2] For living births only. Where no figures are given, reports are not available.
[3] For 1920 figures see the *Statesman's Year Book*, 1921.

four years preceding the war, and for the war years an average of 1,055. The proportion does not remain a constant figure, but drops in the years 1916–17 to rise again in 1918.

Denmark, which was a neutral country, had an average proportion in the years 1911–13 of 1,049, in the war years of 1,051, and in 1919 of 1,064. Switzerland averaged 1,049 from 1910 to 1913, and 1,052 for the war years. For the other countries the data are incomplete, and what there are can furnish no information of value here. In the European countries which have just been reviewed the proportion of male births to female births is so irregular that no positive deductions can be made. Although in England, for instance, the proportion rises during the latter years of the war, it should be noted that this is likewise true for Switzerland and Denmark, which were neutral countries and, as far as loss of male life was concerned, were unaffected. What evidence these figures offer is quite inconclusive in supporting the theory.

Owing to the lack of registration statistics in the United States only the numbers of births by sex since 1915 are available, and these only for the registration area, which constitutes a comparatively small part of the United States. In no state has there been any increase in the ratio of male births over female births decided enough to warrant any conclusions. Thus, in 1919 in Connecticut the proportion rose from 1,041 to 1,068, but in the neighboring state of Massachusetts in the same year it fell from 1,061 to 1,036. Computations for the whole registration area only are given in Table VI.[1]

TABLE VI

Year	Ratio	Year	Ratio	Year	Ratio
1915	1,055	1917	1,058	1919	1,056
1916	1,057	1918	1,058		

The proportion for the whole registration area was greater in 1919 than in 1915, but lower than in the three intervening years, and these figures fail to support the theory advanced. Since the registration area has enlarged each year, the proportions for the registration area as it was in 1915 have been computed for several years, as shown in Table VII.

TABLE VII

Year	Ratio	Year	Ratio	Year	Ratio
1915	1,055	1917	1,053	1919	1,054
1916	1,055	1918	1,056		

These figures likewise fail to show any rise in the ratio during or after the war.

[1] Birth Statistics in the Registration Area of the United States (1915–19).

The general conclusion of the study is that what Düsing considered to be a well-known and undoubted phenomenon is not established by statistical proof. To offset the disproportionate loss of male life from the disasters of war is a matter of such importance to the race that we can scarcely believe that it is left to chance. But to hold that this is accomplished by a rise in the proportion of male births to female births after a period of war is to go contrary to the evidence. If the ratio of the sexes at birth does not change, can the economic and industrial confusion entailed by a war press more heavily on the female sex and so raise the proportion of female deaths to all deaths?

SECTIONAL TRENDS IN DEPARTMENT STORE TRADE, 1919–22

By Lawrence B. Mann

How has the business depression affected retail buying in different sections of the United States? The monthly sales of 156 department stores which report regularly to the Federal Reserve banks form a convenient body of data for use in the analysis of this problem. These stores are distributed through seven of the twelve Federal Reserve districts, and fairly represent department store activity in all sections of the United States except the middle west. In Table I the sales of stores in each Federal Reserve district are totaled for each month and converted into index numbers, the average monthly sales for the three years 1919, 1920, and 1921 being used as a base.

The noteworthy features of these figures are the distinct seasonal fluctuations of trade in each district and the remarkable correlation between the seasonal variations in different sections of the country. In each district there is rather restricted business during January and February; a heavy spring buying season which extends through March, April, May, and June; a very slack season during July and August; and heavy fall buying which culminates in a distinct peak at the Christmas season. These seasonal fluctuations are of about the same degree of sharpness in the Boston, New York, Richmond, Atlanta, and Dallas districts, but are considerably less marked in the Minneapolis and San Francisco districts.

In order to eliminate the effect of these acute seasonal fluctuations, new series of index numbers were constructed for each district, the sales for each month being based on the average sales for the corresponding month of the three years, 1919, 1920, and 1921.

TABLE I

INDEXES OF DEPARTMENT STORE BUSINESS ON UNIFORM BASES

Monthly average sales 1919–21=100

Date	District No. 1 Boston 24 stores	District No. 2 New York 60 stores	District No. 5 Richmond 19 stores	District No. 6 Atlanta 9 stores	District No. 9* Minneapolis 10 stores	District No. 11* Dallas 16 stores	District No. 12 San Francisco 18 stores
1919							
Jan.	71	69	70	64	...	...	65
Feb.	62	61	64	67	...	...	59
March	78	75	90	84	...	...	76
April	91	91	103	86	94	...	82
May	92	89	94	89	107	...	83
June	89	86	92	79	100	...	80
July	68	66	72	72	88	68	78
Aug.	70	63	66	68	83	69	89
Sept.	86	86	89	87	108	99	91
Oct.	110	118	108	103	119	112	107
Nov.	108	115	113	110	113	116	97
Dec.	162	166	169	166	145	174	162
1920							
Jan.	97	100	84	90	95	97	98
Feb.	74	78	73	79	78	88	79
March	107	111	110	106	102	122	104
April	110	106	104	112	110	111	103
May	112	117	105	117	112	115	108
June	113	110	111	100	112	110	101
July	80	80	83	82	98	86	93
Aug.	78	71	80	89	91	87	107
Sept.	98	92	95	98	108	111	103
Oct.	112	123	121	128	115	130	114
Nov.	121	129	128	127	116	131	108
Dec.	162	167	177	171	146	169	167
1921							
Jan.	98	96	87	83	89	87	96
Feb.	79	80	79	81	69	83	85
March	110	106	111	101	96	104	104
April	108	105	101	90	105	90	97
May	107	103	101	95	92	97	103
June	110	102	105	84	95	89	96
July	70	71	72	65	76	65	85
Aug.	75	68	71	72	80	65	106
Sept.	88	84	79	77	89	85	97
Oct.	117	126	113	111	99	106	111
Nov.	113	119	110	103	95	97	103
Dec.	171	170	167	148	127	150	164
1922							
Jan.	91	84	71	68	68	70	89
Feb.	78	76	68	69	56	68	75

* In calculating bases estimates are made for sales of stores in districts No. 9 and No. 11 for the months of 1919 for which we have no reports.

In analyzing these figures it should be remembered that some allowance should be made for normal increase of business during a period of three years. Moreover, as the sales are in terms of dollars, their size is considerably influenced by the level of prices. However, disregarding these two external influences for which it is impossible to make accurate allowance, these indexes show very distinct trends in the period since January, 1919.

In each district there was a distinct upward trend of retail business during the year 1919 and the first few months of 1920. This upward

TABLE II

INDEXES OF DEPARTMENT STORE BUSINESS ON MONTHLY BASES

Average sales for corresponding months 1919–21=100

Date	District No. 1 Boston	District No. 2 New York	District No. 5 Richmond	District No. 6 Atlanta	District No. 9[a] Minneapolis	District No. 11[a] Dallas	District No. 12 San Francisco
1919							
Jan.	80	79	88	81	...	...	76
Feb.	86	83	89	89	...	...	79
March	79	77	86	86	...	...	80
April	89	91	100	90	92	...	87
May	89	86	94	88	103	...	85
June	85	86	89	89	98	...	87
July	93	92	95	98	101	93	91
Aug.	95	94	91	90	99	94	88
Sept.	94	98	101	99	106	101	94
Oct.	98	96	94	90	107	96	97
Nov.	95	95	97	97	104	101	95
Dec.	98	99	99	103	104	106	99
1920							
Jan.	109	113	104	114	110	114	113
Feb.	104	107	101	105	110	112	106
March	110	114	106	109	108	120	110
April	106	105	101	116	107	113	110
May	108	114	105	117	108	114	110
June	109	111	108	114	110	115	110
July	110	110	110	112	112	117	109
Aug.	105	106	110	116	107	118	107
Sept.	108	106	109	112	106	113	106
Oct.	99	100	106	112	104	112	103
Nov.	106	107	109	112	107	114	105
Dec.	98	100	104	106	105	103	102
1921							
Jan.	111	108	108	105	103	102	111
Feb.	110	109	109	107	97	107	114
March	111	109	107	104	102	102	110
April	105	104	99	93	102	92	103
May	103	100	101	95	89	96	105
June	106	103	102	96	93	93	104
July	97	98	96	89	87	89	100
Aug.	100	100	99	94	94	88	105
Sept.	97	96	90	88	88	86	100
Oct.	103	103	99	97	90	92	100
Nov.	99	98	94	91	88	85	100
Dec.	104	101	98	91	91	91	99
1922							
Jan.	102	95	89	85	78	82	103
Feb.	109	104	94	91	79	87	101

[a] In calculating bases estimates are made for sales of stores in districts No. 9 and No. 11 for the months of 1919 for which we have no reports.

movement reached a peak in five of the Federal Reserve districts during the spring or summer of 1920, whereas it did not culminate until the early months of 1921 in New England and on the Pacific Coast. It is noteworthy that the increased buying due to sales and price reductions in New England more than compensated for the loss of trade due to the closing of woolen mills in the summer of 1920, and that sales were only seriously curtailed some months after the depression had spread to the rubber, cotton, shoe, and paper industries. The decline in trade during the fall and winter of 1920 in the Dallas, Atlanta, and Richmond districts was doubtless due primarily to the shrinkage of

cotton values, while the drop in grain prices brought about a similar contraction of retail business in the Minneapolis district. Commencing with June, 1920, the value of sales in the New York district also showed some curtailment, but the decline in both the New York and the Boston districts has been much less pronounced than in the southern and the western districts.

It is impossible to predict whether department stores' sales have reached their lowest point for the current business cycle, but the early months of 1922 have shown an encouraging recovery of trade in the eastern sections, while buying on the Pacific Coast has continued to be well maintained. Department store business in the Richmond, Atlanta, and Dallas districts, on the other hand, is still considerably restricted; while sales in the Minneapolis district have been drastically curtailed during 1922.

WAGE STUDIES OF THE NATIONAL INDUSTRIAL CONFERENCE BOARD: A REPLY

The National Industrial Conference Board has published four reports on changes in wages in the United States.[1] The first two of these reports are examined by Paul H. Douglas, of the University of Chicago, in the September, 1921, issue of this JOURNAL.

The National Industrial Conference Board welcomes fair and constructive criticisms of its reports, since it appreciates that only in this way can the high standard be approached which the Board has set as the goal of its research work. In Mr. Douglas's article, however, there is so much misuse and misinterpretation not only of the data presented by the Board, but also of the data with which the Board's work is compared, as to place the Board's reports in a false light and to warrant a statement in reply.

The two wage studies of the National Industrial Conference Board which Mr. Douglas reviewed were designed as a "survey of changes in wages as measured by earnings" (Research Report No. 31, p. iii) in a number of important manufacturing industries in the United States. There was, therefore, no attempt to discuss the adequacy or inadequacy of wages in relation to the cost of living, because those who were responsible for the reports did not consider that the data available warranted such comparisons.[2] In his review, however, Mr. Douglas ignored the cautions contained in the reports as to what could and what could not be done with the figures, and concentrated his attention upon them primarily to determine the relation of wages to the cost of living.

I

As Mr. Douglas pointed out, three sources of data regarding changes in the cost of living in the United States or any considerable section thereof are avail-

[1] National Industrial Conference Board. Research Reports Nos. 20, 31, 35, 45.

[2] In the Board's later studies of changes in wages, the data were such as to make possible a comparison of earnings with the cost of living so as to show "real" wages, and these comparisons were accordingly made.

able: (1) studies by the National Industrial Conference Board; (2) studies by the Massachusetts Commission on the Necessaries of Life; (3) studies by the United States Bureau of Labor Statistics. He placed most confidence in the estimates of changes in the cost of living as made by the United States Bureau of Labor Statistics. His reason for this is given as follows:

> It will be seen that the figures of the Massachusetts Commission and the National Industrial Conference Board are from six to eighteen points below those of the Bureau of Labor Statistics. In all probability, however, the data of the Bureau of Labor Statistics are more reliable for the larger cities than are those of the other two. The situation in Massachusetts was undoubtedly not typical of the country as a whole, for that state had an oversupply of houses at the outbreak of the war and rents in consequence rose much more slowly there than in other parts of the country. And it is doubtful whether the investigations of the National Industrial Conference Board were made as carefully or as accurately as those of the Bureau.

A careful examination of this statement justifies the following comment:

(1) National Industrial Conference Board. The statement, "It is doubtful whether the investigations of the National Industrial Conference Board [of the cost of living] were made as carefully or as accurately as those of the Bureau," involves a presumption that the two have been painstakingly compared and that there is a justifiable basis for the assertion. There is, however, no evidence that Mr. Douglas ever tried to inform himself as to the methods used by the Board in collecting and analyzing the data which are used in making its estimates of changes in the cost of living—that he ever examined the schedules or the tabulation sheets, or in any other way attempted to ascertain the degree of care and accuracy used by the Board in making its estimates of changes in the cost of living in the United States.

(2) Massachusetts Commission on the Necessaries of Life. The smallness of the increase in the cost of living in Massachusetts, as compared with the increase shown by the United States Bureau of Labor Statistics for the country as a whole, Mr. Douglas explained by saying that rents had not increased so much in Massachusetts as in other parts of the country. As a matter of fact, on every date for which comparable figures were available, the increases in rents in Massachusetts, as reported by the Massachusetts Commission on the Necessaries of Life, were greater than the increases indicated by the figures of the United States Bureau of Labor Statistics on these same dates for the country as a whole, as is shown in the following table. The smallness of the rent increase does not, therefore, explain why the rise in the cost of living as computed by the Massachusetts Commission on the Necessaries of Life was smaller than that reported by the United States Bureau of Labor Statistics. A comparison of the two sets of figures indicates only the character of the research which produced this statement.

(3) United States Bureau of Labor Statistics. The figures just quoted, showing changes in rents in the United States, were collected in 32 cities from which the Bureau of Labor Statistics obtains costs for all of the items constituting the total cost of living. These data from 32 cities are combined by the Bureau to indicate the average change in the cost of living for the country as a whole, and have been available in this form since October, 1920.[1] *The figures Mr. Douglas*

[1] *Monthly Labor Review*, Oct., 1920, p. 65; general estimates were published by the Bureau in the October and November, 1919, numbers of the *Labor Review*.

RENT INCREASES IN MASSACHUSETTS AS REPORTED BY THE MASSACHUSETTS COMMISSION ON THE NECESSARIES OF LIFE, AND IN THE UNITED STATES AS REPORTED BY THE UNITED STATES BUREAU OF LABOR STATISTICS, 1913 TO SEPTEMBER, 1921, INCLUSIVE *

Average in 1913 to—	Massachusetts M. C. on N. of L.	United States U. S. B. of L. S.
	Per cent	Per cent
December, 1914	3.5	No change
December, 1915	4.1	1.5
December, 1916	5.3	2.3
December, 1917	3.1	0.1
December, 1918	16.4	9.2
June, 1919	15.5	14.2
December, 1919	29.6	25.3
June, 1920	39.4	34.9
December, 1920	51.7	51.1
May, 1921	59.4	59.0
September, 1921	61.0	60.0

* Report of the Special Commission on the Necessaries of Life, Jan., 1922, p. 107; *Monthly Labor Review*, Nov., 1921, p. 83.

used to represent changes in the cost of living in the entire United States were averages of only 18 cities—shipbuilding centers where, as the Bureau of Labor Statistics itself has said, "industry was most stimulated and population most congested, with a consequent tendency to price raising." In June, 1919, it was estimated that the increase in the cost of living in the 18 shipbuilding centers was 10 points higher than in other cities and towns, and 5 points higher than for the country as a whole.[1]

Mr. Douglas says these figures for the shipbuilding centers "are more reliable for the larger cities" than are those of the Massachusetts Commission on the Necessaries of Life or the National Industrial Conference Board. The use to which he put them was, however, to show the relation between the cost of living and wages in specified industries. None of these industries is concentrated in the large cities but, on the contrary, the industries are located in towns of various sizes in all sections of the country.

II

When the increase in the cost of living in the 18 shipbuilding cities, where prices were recognized to have increased more than in the country as a whole, was related to the increase in wages as shown in reports of the National Industrial Conference Board, it was still found that real wages were higher than they were before the war. This conclusion was so at variance with Mr. Douglas's own theories[2] regarding the relative economic status of American workmen in 1920 and before the war that it had to be explained. To do this he attempted to show that the rise in wages between 1914 and 1920 reported by the Board was more apparent than real. For this purpose he compared the Board's figures for hourly earnings and for full-time weekly earnings with similar figures of the United States Bureau of Labor Statistics for the boot and shoe industry, woolen and worsted manufacturing, and cotton manufacturing.

[1] *Monthly Labor Review*, Oct., 1919, p. 1.

[2] See, for example, *Amer. Economic Rev.*, Sept., 1921, p. 409 *et seq.*

This comparison brought out the fact that for most occupations in each industry both hourly earnings and full-time weekly earnings as reported by the Board were lower in 1914 and higher in 1918 than those reported by the Bureau, which, of course, indicated a greater increase between the two dates as reported by the Board than as reported by the Bureau. Mr. Douglas has five explanations for these differences, designed to justify the Bureau's figures and to discredit those of the Board.

The first of these is that the Bureau's figures are averages for the years 1914 and 1918 while those of the Board are for September, 1914, and September, 1918. Mr. Douglas thought that "this might partially explain the greater increase shown by the Conference Board." As a matter of fact, it probably very largely explains the difference. A comparison between the year 1914 and September, 1914, and between the year 1918 and September, 1918, is impossible. A twelve-months' average irons out many fluctuations in wages which might appear from month to month. September in normal times is between seasons for many occupations, and piece-workers especially would earn less in that month in 1914 than their average for the year. In a period of rapidly rising wages such as the year 1918, with almost all seasonal fluctuations eliminated, the average for the year might well be less than in September, the ninth month. There is, therefore, no necessary discrepancy between the two sets of figures.

The other four explanations are not so important as reasons for the difference between the Board's wage figures and those of the Bureau of Labor Statistics, although two of them are worth mentioning as evidence of Mr. Douglas's method. In his attempt to show that the Board's figures were not geographically so representative as those of the Bureau, he called attention to the fact, noted in the Board's own reports, that for cotton manufacturing wages data were obtained only from northern mills. *But for the purpose of discrediting the Board's figures he compared these figures for northern mills only with the Bureau's figures for northern and southern mills combined.* It is, of course, common knowledge that conditions in the southern cotton mills are in so many ways different from those in the north that a comparison of wages in the mills of the north only with wages in the mills of both north and south is utterly meaningless.

Another explanation offered by Mr. Douglas for the difference between the Board's figures and those of the Bureau of Labor Statistics was that "the plants investigated by the Conference Board were undoubtedly almost overwhelmingly non-union, while those of the Bureau included union as well as non-union plants. The membership of the Conference Board is predominantly composed of employers operating non-union shops, and it is from their members that practically all of their wage statistics are taken. Now it is undoubtedly true in general that wages in non-union plants in 1914 were lower than those in union plants," and that during the war they rose more rapidly in non-union plants than in union plants. This statement is another evidence of Mr. Douglas's failure to inform himself as to the basis of the Board's investigations. Had he attempted to do so, he would have found that the distribution of the questionnaires used for the Board's wages investigations are not limited to the Board's own membership but that, on the contrary, the questionnaires are sent to establishments in the

different industries regardless of their affiliations, regardless of their labor policies, and without a consideration as to whether they are or are not union shops. Moreover, there is no way of determining from the returned questionnaires themselves whether the shop represented is closed or open, union or non-union. The Board is not interested in that matter in its wages investigations, and its questionnaires have no bearing either designedly or otherwise on union or non-union conditions.

From all of which it seems fair to conclude, not, with Mr. Douglas, that the rise in real wages shown by the National Industrial Conference Board has not been established, but rather that "the writer [of the review] believes that from 1914 to 1918 the purchasing power of hourly wage rates decreased appreciably," and that he set out to discredit any evidence which did not confirm this thesis. For this purpose he has misused, misinterpreted, or deliberately ignored pertinent data relating both to the cost of living and to wages. So far as the comparison of the Board's wage figures with the wage figures of the Bureau of Labor Statistics goes, there is no question as to which is right or which is wrong. They relate to different periods of time and the data were collected by different methods. The fact that they agree as well as they do is more remarkable than that there may be differences between them.

III

By relating actual earnings in the different industries as reported by the National Industrial Conference Board to the amount necessary to support a family of five on "a minimum standard of health and comfort," Mr. Douglas carried one step further his attempt to show the unfavorable economic position of the American wage-earner. Average yearly earnings are not given in the Board's reports, but he assumed that the average earnings of adult males for one week, multiplied by fifty-two, would provide this figure. Having thus secured average yearly earnings of adult males in the twelve different industries represented, it was necessary to find the actual cost of living. No cost of living figure being available for workers in these industries, he further assumed that the cost of living of a family of five in Philadelphia was representative of the cost of living of workers in the industries manufacturing boots and shoes, chemicals, and the other ten industrial classifications, no matter where they were located. A comparison of the average yearly earnings of adult males in twelve different industries, obtained by multiplying earnings for one week by fifty-two, with the cost of living of a family of five in Philadelphia in the fall of 1918, brought Mr. Douglas to the conclusion that from 23 to 81 per cent more wages was needed in ten of the twelve industries to bring the average earnings of adult males up to the minimum cost of living. A similar comparison for March, 1920, indicated to him that in nine industries from 22 to 59 per cent more was needed to bring earnings up to the minimum cost of living.

The principal objections which might be raised to such procedure for determining the adequacy of wages Mr. Douglas himself presented but dismissed uncertainly and unconvincingly. Each one of these objections, however, is valid. The cost of living does vary greatly from place to place, and no measure of costs in one place can, without careful testing, be taken to measure costs

in another. Moreover, the average size of American wage-earners' families in which the father's wages are the only source of income is almost certainly less than five, and in families where there are five persons the average number of wage-earners is almost certainly two at least. This matter is so fully discussed in Research Report No. 41, of the National Industrial Conference Board, as not to require presentation at this point. Another analysis of the same problem from a somewhat different point of view is contained in an article by the present writer in the *American Economic Review* for September, 1921.

The problem of the economic responsibilities of adult male American wage-earners is far from settled and, as has already been pointed out, much careful research is needed before an answer to the question can finally be made. In the meanwhile, however, scientific accuracy requires that figures showing the cost of living or changes in the cost of living be used with extreme care, especially in connection with wages.

It should again be emphasized that the wage studies of the National Industrial Conference Board reviewed by Mr. Douglas were designed primarily to show trends in wages. The uses to which he put the figures were in several instances not justified, and some of his comparisons, both with other wage studies and with studies of the cost of living, were unwarranted. To make his points he undertook a number of elaborate calculations, some of which are open to serious question. Numerous minor points on which the present writer disagrees with Mr. Douglas have not been taken up in the present paper, but enough has been said to indicate that Mr. Douglas's interest in the wage studies of the National Industrial Conference Board was apparently more in relation to his own theories than to the intrinsic value of the studies themselves.

MARGARET LOOMIS STECKER

Research Staff,
National Industrial Conference Board

A REJOINDER

I take it that Mrs. Stecker objects to my review fundamentally on the ground that its criticism of the wage studies of the National Industrial Conference Board was based on insufficient evidence and was animated primarily by a desire to discredit their conclusions in favor of certain others of my own. Naturally, what first attracted my attention to these studies was their divergence from those investigations of the Bureau of Labor Statistics with which I had been dealing. The problem so aroused my interest that I tried to find the reasons for these differences. Further research convinced me that the Bureau's figures were more accurate than those of the Board, for the reasons which I tried to indicate in my review and which I shall once more try to summarize below. I shall take up Mrs. Stecker's criticisms in order.

1. I preferred the cost of living figures of the Bureau of Labor to those of the Massachusetts Commission because the Bureau's figures covered a large number of cities distributed over the country as a whole, while the Massachusetts figures referred only to that state. I agree that I was in error in my statement

that rents had risen far more slowly in Massachusetts than in the rest of the country, although interestingly enough the cost of living statistics of the Conference Board itself would lead one to the identical statement that I made.[1] However, I do not believe that Mrs. Stecker herself would seriously argue that the Massachusetts figures should be preferred as a country-wide index to those of the Bureau. Furthermore, I believe that the Bureau's cost of living figures are more reliable than those of the Conference Board for the following reason: The food index for both studies is the same, the Conference Board merely using that of the Bureau; but the difference in the methods pursued by the two bodies in collecting the other price data is the most significant. All of the original data secured by the Conference Board have always been collected by means of questionnaires sent out to dealers and local groups throughout the country. The data of the Bureau of Labor Statistics, on the other hand, are based upon an extensive collection by field agents in the specific localities covered both (a) of family budgets and (b) of the actual prices of commodities from 1914 on to the present by periods. In the light of this fact, I imagine that all statisticians will agree that my statement that "it is doubtful whether the investigations of the National Industrial Conference Board were made as carefully or as accurately as those of the Bureau," was both moderate and thoroughly justified.

I selected the 18 shipbuilding cities because they were the only localities for which a continuous record existed for the period covered by the wage studies themselves, *i. e.*, from 1914 on. The statistics for the 13 additional cities, which Mrs. Stecker mentions, began only in December, 1917. Nevertheless, I am inclined to agree that it would have been better had I used these 13 cities for the period which they cover. This would have lowered the cost of living index by approximately only 3 points in September, 1918, and by 4 points in March, 1920.

2. The relative reliability of the various cost of living indexes, however, is by no means so important as the question of the relative reliability of the wage data of the Conference Board for the period 1914–18[2] as compared with those of the Bureau of Labor Statistics. I was struck with the fact that the wage statistics of the Conference Board were greatly in excess of those shown by the Bureau for three of the same industries during almost identically the same period. After a close analysis of these three industries, it was found that with identical methods of computation the Board's figures showed an increase in hourly earnings of from 17 to 29 points more than those of the Bureau, and that those for full-time weekly earnings ranged from 11 points higher, as in the case of boots and shoes; to 33 points, as in the case of cotton manufacturing. De-

[1] See Research Report No. 30. National Industrial Conference Board, pp. 7–12. The average increase in rents for the country as a whole, during the period July, 1914–July, 1920, according to the Board, was 58 per cent. Of the 59 cities, however, where rents had increased over 61 per cent, only 1 was in Massachusetts; 2 of the 26 cities with increases ranging from 51 to 60, and 4 of the 29 cities with increases of from 41 to 50 per cent, were in Massachusetts. There were no less than 6 Massachusetts cities, however, in the 44 with increases of less than 40 per cent.

[2] Mrs. Stecker's implication that I compared the Board's figures with those of the Bureau for the period 1918–20 as well, is erroneous, as the reader of the original review will see. Nor did my independent study go beyond 1918.

spite Mrs. Stecker's contentions, such large differences, amounting in the case of cotton manufacturing to a wage difference of approximately 15 per cent, can be explained only in part by the fact that the Bureau's statistics are for the average of the years in question, while those of the Board are for the month of September. As I indicated, probably by far the largest part of the difference is caused by the different methods of sampling, and I invite a close comparison of the methods used by the two bodies. The Bureau's figures were based upon over 35 per cent more employees in the woolen industry than were those of the Conference Board, upon over 420 per cent more in the case of boots and shoes, and upon 550 per cent more in the case of cotton manufacturing. They were, moreover, collected, in the main, from a wider geographical area, and hence are more reliable as a country-wide index. Mrs. Stecker makes much of the fact that questionnaires were sent to union shops. Has she any assurance, however, that these union shops filled out and returned the questionnaires to the Board in the same proportion as those firms which were members of the Board? In view of the known membership and industrial policies of the Conference Board, are not, indeed, all the probabilities of the case exactly the opposite?

The chief source of difference, however, arises I think from the fact that the Board uses the questionnaire method of collecting wage data, while the Bureau, for the three industries which I compared, used field agents. Now questionnaires are much more likely to produce biased results than schedules administered by field agents, because firms with a low wage scale, or whose increases have been less than the average, are naturally reluctant to fill them out, even though their anonymity is preserved; plants with a high wage scale or that have increased wages above the average will, on the other hand, be much more inclined to return the questionnaires. The indicated increase therefore will tend, almost inevitably, to be greater than the real increase. This danger is avoided by the use of field agents, who can more easily secure data from the low-wage firms or those that have made smaller increases than the average.

3. Finally, I take it that no defence is needed for my attempt to make comparisons of what the average yearly earnings in the various industries would have amounted to on the basis of the given weekly rates, with Mr. W. C. Byer's meticulously careful Philadelphia standard budget. Mrs. Stecker admits that I pointed out the possible objections to such a comparison. She merely emphasizes them more strongly. Space is lacking fully to discuss this subject, and I can only refer the interested reader to my original review where he will find the various points, both pro and con, fully stressed.

Fundamentally, my objection to the studies of the National Industrial Conference Board, whether it be their hours and output series, their cost of living series, or their wage series, is that the studies are all based upon the questionnaire method of collection and a dubious method of sampling. The choice of samples is such a delicate matter, and the voluntary questionnaire method is so susceptible to biases and errors, that few would accept it in preference to data derived from actual field investigations. This basic objection Mrs. Stecker completely avoids in her reply.

In closing, may I correct two errors in the original review which Mrs. Stecker

does not mention and the corrections of which were in the editor's hands long before her manuscript was received. In Table I, the unweighted average for actual weekly earnings in March, 1920, should be 237 instead of 235 as printed, and the weighted average should be 235 instead of 234. Secondly, the last two column headings in Table II should be transposed.

PAUL H. DOUGLAS

AN ALL-INCLUSIVE EMPLOYMENT INDEX FOR WISCONSIN

The Statistical Department of the Wisconsin Industrial Commission is constructing an all-inclusive employment index, beginning with January, 1922. Since July, 1920, the department has published a monthly employment index covering mining, quarrying, and manufacturing. A quarterly index including the same groups was also instituted which ran back to the first quarter of 1915.[1]

The new index covers all of the important groups of employment. The kinds of employment represented, together with the number of correspondents in each group, are given in an accompanying list. At least one third of the total number of employees in the state are represented in each of the employment groups except agriculture, building, trade, and miscellaneous professional service.

Although there are 498 correspondents in agriculture, they employ only 0.5 per cent of the farm laborers in the state. In building, about 5 per cent of the state pay-roll is represented; in retail trade, about 15 per cent; and in wholesale trade, about 10 per cent. Professional service, which is a rather heterogeneous group includes nurses, barbers, doctors, lawyers, insurance agents, and real estate agents in the employ of another. Only 1 or 2 per cent of the state pay-roll is represented in this group. In some groups, as Express, Telephone and Telegraph, much more than one third of the state pay-roll is necessarily represented, by reason of the fact that such businesses are natural monopolies.

An index number for each group of employment has been constructed, with January, 1922, as 100. An index number for all groups has not yet been prepared because it has not been determined what weights to assign to the various groups. Within the manufacturing group it is possible to estimate rather accurately the percentage of the state pay-roll represented in each industry by using the 1919 United States Census of Manufactures. But the Census of Occupations is a less satisfactory guide in determining what percentage of the state pay-roll in other major employment groups is represented. This is due to the fact that the Census of Occupations follows occupational rather than industrial lines. Moreover, the division between employees and employers is not clearly drawn.

The original data are secured directly from employers through a very simple questionnaire. The Wisconsin Crop Reporting Service is coöperating with the Industrial Commission in sending out the agricultural questionnaires. Although the form varies slightly for the various employment groups, the essential informa-

[1] See "An Employment Index for Wisconsin," p. 497, this JOURNAL for Dec., 1920.

tion called for is: (1) the number of employees on the pay-roll including the 15th day of the month; (2) the total amount of such pay-roll.

After reducing all pay-rolls to a weekly basis, average weekly earnings are obtained by dividing the total pay-roll in each group by the total number of employees. The index number for total employees, the total pay-roll, and the average weekly earnings are then constructed.

The new index number is calculated by comparing the reports of identical establishments in the base month (January, 1922, for the new index) with the reports in the given month. In other words, the same original establishments are used each month instead of a fluctuating number. In the case of agriculture, however, a fluctuating number of correspondents submit data. The index number for the period 1915 to July, 1920, was constructed by first computing quarter-to-quarter link relatives and then shifting the base to the first quarter of 1915. The index number for the period July, 1920, to January, 1921, was constructed from the reports of practically the same establishments each month, although in some months the month-to-month link relative method had to be used.

It is believed that the new all-inclusive index number conforms to all of the criteria set forth by Ernest S. Bradford in a recent article appearing in this publication,[1] so far as they apply to employment statistics, with one exception. Mr. Bradford states that "the figures should show partial unemployment (part-

GROUPS OF EMPLOYMENT	NUMBER OF CORRESPONDENTS
I. MANUAL	
Agriculture	468
Logging	13
Mining	6
Lead and Zinc	3
Iron	3
Stone Crushing and Quarrying	12
Manufacturing	485
Stone and Allied Industries	17
Brick, Tile, and Cement Blocks	11
Stone Finishing	6
Metal	87
Pig Iron and Rolling Mill Products	4
Structural Iron Works	4
Foundries and Machine Shops	41
Railroad Repair Shops	6
Stoves	4
Aluminum and Enamel Ware	3
Machinery	10
Automobiles	3
Other Metal Products	12
Wood	87
Sawmills and Planing Mills	31
Box Factories	9
Panal and Veneer Mills	5
Sash, Door, and Interior Finish	21
Furniture	11
Other Wood Products	10
Rubber	5
Leather	25
Tanning	3
Boots and Shoes	5
Other Leather Products	17
Paper	23
Paper and Pulp Mills	8
Paper Boxes	6
Other Paper Products	9
Textiles	28
Hosiery and Other Knit Goods	8
Clothing	7
Other Textile Products	13
Food	101
Meat Packing	3
Baking and Confectionery	16
Milk Products	7
Canning and Preserving	32
Flour Mills	14
Tobacco Manufacturing	15
Other Food Products	13
Light and Power	13
Printing and Publishing	63
Laundering, Cleaning, and Dyeing	32
Chemicals (including Soap, Glue, Explosives)	4
Construction	124
Building	89
Highway	24
Railroad	5
Marine, Dredging, Sewer Digging	5
Communication	27
Steam Railway	8
Electric Railways	11
Express, Telephone and Telegraph	8
Wholesale Trade	15
Hotels and Restaurants	71
II. NON-MANUAL	
Manufacturing, Mines and Quarries	
Construction	
Communication	
Wholesale Trade	
Retail Trade—Sales Force Only	46
Teachers	69
Urban	45
Rural	24
Miscellaneous—Professional-service	12
Hotels and Restaurants	

[1] "Methods Used in Measuring Unemployment," p. 990, Dec., 1921.

time employment) as well as complete unemployment." The present writer does not believe that it is possible to secure part-time employment data each month from any considerable number of employees by the use of the questionnaire method. He believes that the change in average weekly earnings, while made up of the two elements, rates of pay and amount of time worked, gives some idea of part-time employment. At semi-annual or annual intervals it is possible to send out more elaborate questionnaires, followed up by field agents, to obtain data on part-time employment. The New York Department of Labor in the February number of the *Industrial Bulletin* publishes the result of an investigation into hours of labor, which is the sort of thing the writer has in mind.

The Wisconsin employment data described above are published monthly in the *Wisconsin Labor Market*. Members of the American Statistical Association wishing to be placed on the mailing list should address the Statistical Department, Wisconsin Industrial Commission, Madison, Wisconsin.

A. J. ALTMEYER

Wisconsin Industrial Commission

THE DIVISION OF VITAL STATISTICS OF THE UNITED STATES BUREAU OF THE CENSUS

In order to make available information concerning the various bureaus of the United States Government which carry on activities concerned with the public health, the National Health Council[1] has issued six reports. Since members of the American Statistical Association are interested in the Division of Vital Statistics of the United States Bureau of the Census, a résumé of the report on this Bureau is not out of place in this JOURNAL.

HISTORY AND DEVELOPMENT OF THE BUREAU

The first annual mortality report related to the year 1900 and was published in 1906 as part of a report covering the five years, 1900–04. Previous to that time, mortality reports based on enumerators' returns had been published as early as 1850 and again in 1860 and 1870. Decennial reports and registration records were published in 1880, 1890, and 1900 (census years). There was a registration area as early as 1880, which was enlarged in 1890 and again in 1900, so that it included in 1900 the six New England States, Indiana, Michigan, New Jersey, New York, and the District of Columbia.

Since 1900 the following states have been admitted to the death registration area: 1906, California, Colorado, Maryland, South Dakota, and Pennsylvania; 1908, Washington and Wisconsin; 1909, Ohio; 1910, Minnesota, Montana, North

[1] The National Health Council is composed of the following organizations: American Public Health Association; American Red Cross; American Social Hygiene Association; American Society for the Control of Cancer; Conference of State and Provincial Health Authorities of North America; Council on Health and Public Instruction of the American Medical Association; National Child Health Council (including the American Child Hygiene Association, the National Child Labor Committee, and the Child Health Organization of America) National Committee for Mental Hygiene; National Organization for Public Health Nursing; National Tuberculosis Association; and the U. S. Public Health Service, as Conference Member.

Carolina (municipalities of 1,000 and over), and Utah; 1911, Kentucky and Missouri; 1913, Virginia; 1914, Kansas; 1916, North Carolina (remainder of state) and South Carolina; 1917, Tennessee; 1918, Illinois, Louisiana, and Oregon; 1919, Delaware, Florida, and Mississippi; 1920, Nebraska. There are also 17 registration cities in non-registration states, making a total of 34 states, the District of Columbia, and 17 cities, or over 80 per cent of the total estimated population of the United States. Only 3 states remain with unsatisfactory registration laws—South Dakota, which had been admitted but was later dropped, Nevada, and Arizona. This leaves 11 states with satisfactory laws which will be ready for admission as soon as they can show 90 per cent complete registration.

The first annual report on birth statistics related to the year 1915, though prior to that time reports of births had been made in the decennial census reports. In 1915 a birth registration area was created, including Connecticut, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and the District of Columbia. In 1916 Maryland was added; in 1917, Indiana, Kansas, Kentucky, North Carolina, Ohio, Utah, Virginia, Washington, and Wisconsin were added. None was added in 1918, and in 1919 Rhode Island was dropped because of failure to send in all transcripts of birth certificates for the year. California, Oregon, and South Carolina were added in 1919, and Nebraska in 1920. Rhode Island was readmitted in 1921, and New Jersey also was recently admitted. Thus, 25 states and the District of Columbia, or over 60 per cent of the total population of the United States, are included in the birth registration area.

ACTIVITIES OF THE BUREAU

In addition to the principal work of compiling birth and death statistics, the Division also makes up life tables, encourages and promotes uniformity in the local registration laws for births and deaths, issues weekly reports of deaths occuring in sixty of the larger cities, makes special studies of various subjects relating to vital statistics, and coöperates in the statistical work of other government departments and with extra government agencies interested in vital statistics.

Statistics of Births and Deaths.—The statistics of the Division are based upon local records. Certificates of birth and death are made by physicians, midwives, and undertakers, for the city or the county records. For several years the Bureau of the Census has been urging upon local governments the adoption of standard forms for these certificates, and its efforts have met with considerable success. It employs agents to make transcripts of certificates for transmission to the Bureau of the Census in Washington. These agents receive, as a rule, compensation at the rate of three cents for each certificate transcribed. Upon their receipt in the Bureau of the Census the transcripts are edited, and the data are tabulated by the punched-card system and assembled in report form. Reports of birth and death statistics are published in separate volumes annually, by calendar years.

Promotion of Local Registration.—In order to extend the registration

area the Bureau of the Census directs a considerable part of the effort of the Division of Vital Statistics to promoting adequate registration in localities outside the present area. In fact, one of the great accomplishments of the Division has been the building up of the registration area from practically nothing to its present nearly complete status. This promotion work consists in educating committees, societies, state legislatures, and the public generally, through publications and press notices, as to the importance of complete registration. It also includes a system of testing the completeness of registration of births and deaths in the various states by means of form letters addressed to clergymen, postmasters, rural carriers, and others, calling for information regarding recent births and deaths.

Manual of Causes of Death.—The American edition of the *Manual of the International List of Causes of Death*, which is the standard authority on this subject, is published by the Division. The Division also publishes the *Index of Joint Causes of Death* and the *Physicians' Pocket Reference*, more than 148,000 copies of which were distributed during the fiscal year 1919.

Life Tables.—Life tables which show the rate of mortality and the number of years of expectation of life of various age groups are constructed. In most cases the geographical field covered by these statistics is limited to the states which for a long time have had an adequate registration of deaths. These states are New York, New Jersey, Indiana, Michigan, and the six New England States, and the District of Columbia. The material used in the construction of these tables includes the estimated populations as of July 1, 1910, and the deaths in the calendar years 1909, 1910, and 1911.

The first publication of life tables was issued in 1916, the statistics referring to the year 1910. A more complete publication is now in press, entitled, *United States Life Tables 1890, 1901, 1910, and 1901–1910.*

Weekly Health Index.—The Division receives weekly telegraphic reports of deaths from 60 of the largest cities. The figures are published in multigraphed statements within seventy-two hours after the close of the week to which they relate. They show, in addition to the number of deaths occurring, (a) the number of deaths in corresponding prior periods of time, (b) the estimated populations, (c) the death rate per year, (d) the number of deaths of infants under one year of age, and (e) the estimated infant mortality rate.

Special Studies.—Monographs are issued from time to time on subjects related to vital statistics. Among these monographs may be mentioned, for purposes of illustration, those relating to cancer and other malignant tumors, influenza mortality, and the standard nomenclature of diseases and pathological conditions, and of injuries and poisonings which have recently been published.

ORGANIZATION

The Division is under the direction of a chief statistician, W. H. Davis, M.D. There is at present, according to Dr. Davis, a personnel of 124, including the staff in Washington, D. C., and those in the field.

The chief statistician is assisted by an expert chief of division who is in immediate charge of the clerical force and of the production of the work. The

Division is a complete unit in itself; it is related to the rest of the Bureau of the Census only in that it obtains from the Division of the Population and from the Geographer facts of population for census and intercensal years for purposes of calculating rates. The Division also has its own mechanical equipment.

The Division has an appropriation of $825,000 for the three years constituting the decennial period, the first year of which ended June 30, 1920. This amount is divided into $250,000 yearly, and $75,000 for printing.

JAMES A. TOBEY

National Health Council

MISCELLANEOUS NOTES

New Wholesale Price Index. The Federal Reserve Bank of New York has recently completed the preparation of an index number of the prices of twenty basic commodities with the object of securing a representative index which can be carried forward from week to week from readily available quotations. The index is an aggregate of weighted prices of twenty raw materials at primary markets. The commodities contained in the index were selected because of their representative character in agriculture, industry, and trade. The weights were determined in the first instance by the amounts of the different commodities produced in the United States and imported from the years 1913 to 1920, but these weights were adjusted so that agriculture, mining, and manufacture might be weighted in accordance with their importance. A thorough search of sources was made in order to secure for each commodity a representative quotation which would be available promptly. The following commodities were included and weighted as indicated: wheat, 9; corn, 5; hogs, 7; steers, 7; sugar, 3; hides, 6; wool, 4; silk, 1; cotton, 11; rubber, 2; pig iron, 8; copper, 3; lead, 1; coal, 12; petroleum, 5; lumber, 7; cement, 1; paper, 4; sulphuric acid, 1; tobacco, 3.

Statistics of Public Accidents. The Statistical Committee of the Public Safety Section of the National Safety Council is planning a reporting system for public accidents in American cities. It is proposed first to establish a registration area for public accidents. The committee has drafted forms for uniform recording of the following types of public accidents: highway vehicular accidents, highway non-vehicular accidents, buildings and structures accidents, general accidents, and elevator accidents. Two sets of forms are provided: first, a preliminary record of the accident made by the police or safety officer at the time of the accident, and second, a more complete form giving details developed after investigation and abstracted from court records. The detailed form is to be forwarded to the Public Safety Section of the National Safety Council at convenient times during the year, and the results are to be tabulated and published for the information of the safety movement. Dr. L. I. Dublin is chairman of the committee having this work in charge. Information regarding the reporting system may be obtained from Mr. F. M. Rosseland, Chief, Public Safety Section, National Safety Council, 168 N. Michigan Avenue, Chicago, Illinois.

A New British Trade Barometer. The London School of Economics and Political Science (University of London) has followed the example of Harvard University in developing a monthly "Barometer" of the condition of trade and finance. After preparatory work throughout the year 1921, the first results were published in the "Reconstruction of Europe" supplement of the *Manchester Guardian*, April 20, and the publication in this form is arranged for six months, at the end of which time it is hoped that the undertaking will be put on a permanent footing. The barometer gives a large number of series, monthly from January 1919, selected as illustrating the tone of the money and securities markets, production, prices, foreign trade, and employment; these are shown both in tabular and graphic form. From the series are selected four which are believed to be specially symptomatic, and it is hoped that sufficient experience will soon be obtained to allow useful descriptions and even forecasts of the general state of trade. Besides the main section which deals with Great Britain, similar accounts are obtained from Germany, Italy, France, and Belgium, and the whole is given in conjunction with the Harvard account of the United States. The work in London is under the direction of Professor A. L. Bowley.

Report on the Coal Miners. The Russell Sage Foundation has published recently the conclusions of its investigations of the coal industry in a report entitled, *The Coal Miners' Insecurity*. Most of the investigations, which have been carried on for several years, were under the direction of Dr. Louis Bloch. The analysis of the industry points to the outstanding fact of the workers' economic insecurity, due in large measure to the irregularity of employment and the amount of unemployment, which makes a marked discrepancy between earnings and the rate of pay. Such insecurity is traced directly to the organization of the industry, which is greatly over-expanded. The various conclusions of the report are discussed under the following topics: the consumption of coal, the capacity of the mines, the increase in mines and miners, intermittent employment and its causes, seasonal variations, the earnings of bituminous miners, absenteeism, and the cost of living. The presentation of the statistical material is made particularly attractive by the excellent charts drawn under the supervision of Mr. Ralph G. Hurlin, statistician of the Foundation.

Changes in the Research Organization of the Federal Reserve Board. On May 1 the headquarters of the Division of Analysis and Research of the Federal Reserve Board were transferred from New York City to Washington, D. C. Dr. H. Parker Willis has tendered his resignation as director of the Division, to become effective July 1, but he will continue to work with the Division as consulting economist. Dr. W. H. Steiner has been appointed acting chief, and Mr. H. W. Van Pelt, assistant chief. Mr. Van Pelt will supervise the foreign work of the Division. He will be assisted by Mr. Robert B. Warren, formerly associate editor of the *American City Magazine*, Mr. G. B. Sherwell, formerly assistant manager of the Foreign Department of the Battery National Bank of New York, Mr. M. Nadler, and Miss Ruth Peterson, each of whom will devote attention to a special group of countries. The work on domestic business con-

ditions will be under the supervision of Mr. Lawrence B. Mann, who will be assisted by Mr. Woodlief Thomas. Thus, the work of the Division will continue substantially along the same lines as heretofore, principal consideration being given to domestic and foreign business conditions. Careful attention will be given to the perfection of the regular services in each of these two fields, and special studies on topics of interest will be made from time to time as deemed desirable.

Special Meetings of the Association. A special meeting of the American Statistical Association, arranged by the Committee on Business Research, was held on April 13 at the Machinery Club in New York City, the subject for discussion being "Research in Advertising Agencies." Addresses were given by C. W. Hoyt, of Hoyt's Service, Inc., on "The Work of an Advertising Agency"; by Stewart Mims, of the J. Walter Thompson Co., on "The Problem of Research to the Agency and its Clients"; by Joseph Richards, of Joseph Richards Co., on "Methods of Agency Research for its Clients"; and by C. A. Hoppock, of H. K. McCann Co., on "The Use and Methods of Research for the Agency." About 100 members and guests were present.

The Committee on Business Research is planning to hold another meeting in New York early in June, and two or three additional meetings during the fall and early winter. The Committee hopes, through these meetings and through its other activities, (a) to aid in more clearly defining the purpose and scope of business research, to the end that its proper place in a business organization may become more apparent and that the most effective relating of research to management may be brought about; (b) to promote discussion of the methods of such research; and (c) to encourage the interchange of ideas and information among persons engaged in business research.

Convention of Labor Officials. The ninth Annual Convention of Governmental Officials of the United States and Canada was held at Harrisburgh, Pa., May 22-26. The program included a child welfare session, and sessions for the discussion of the chief labor problems—mediation, conciliation, compensation, minimum wage and hours, etc. Many labor commissioners were present, and there was a large delegation of labor officials representing the federal government.

The Department of Labor and Industry held its annual meeting at the same time, and included, among others, sessions of safety engineers, the Advisory Council on Women and Children, and the Industrial Editors Association.

English Economics Journal. *Economica*, the journal of the London School of Economics in which original work by those connected with the School and others finds its vent, is now well established. The fifth number of the journal has just been published. (Annual subscription 7s 6d, to the Secretary, School of Economics, University of London. Issued three times a year.)

Population of Canada by Provinces. The following figures for 1921 are preliminary only, and subject to revision upon the completion of the census:

Alberta, 588,702; British Columbia, 524,563; Manitoba, 612,565; New Brunswick, 387,876; Nova Scotia, 523,837; Ontario, 2,929,054; Prince Edward Island, 88,615; Quebec, 2,349,067; Saskatchewan, 762,004; Yukon, 4,162; North West Territories, 6,684; Royal Canadian Navy, 485.

Meeting of the Committee on the Growth of Children. A third meeting of the Committee of Representatives of National Organizations interested in the study of growth of children was held at the office of Dr. L. Emmett Holt, New York City, on March 4, to discuss plans for standard tables of heights and weights of children. The members of the committee, which is constituted an advisory committee of the National Child Health Council, are: Drs. L. Emmett Holt, Chairman; Bird T. Baldwin, Taliaferro Clark, Louis I. Dublin, W. R. P. Emerson, S. McC. Hamill, Frank Manny, W. T. Porter, Anna E. Rude, Edgar Sydenstricker, Thomas D. Wood, Robert M. Woodbury, and Mrs. Ira Couch Wood.

The University of London is granting a new degree in Commerce which has attracted a very large number of students. The first group of candidates will proceed to their final graduation examination in the summer.

Professor Edmund E. Day has resigned his professorship at Harvard University, to take effect in February, 1923, in order to undertake new and more varied duties at the University of Michigan. The new appointment carries with it the titles of Professor of Economics, Chairman of the Department of Economics, and Director of the Curricula in Business Administration.

Dr. Frederick L. Hoffman, third vice-president and statistician of the Prudential Insurance Company, has accepted a position with the Babson Institute at Wellesley Hills, Mass. He is to be dean of the Graduate School of Business Administration, which is a new feature of the Institute. Dr. Hoffman took up his new duties the first of May, but he still retains his connection with the Prudential Insurance Company, and as far as is possible his services will remain available to the government, insurance companies, and other businesses, to labor, and to voluntary health and welfare promoting agencies.

Dr. Hoffman has recently returned from a seven months' trip across South America, undertaken for the purpose of scientific inquiry into problems of tropical mortality and their relation to insurance. As yet no publicity has been given to the results of his investigations.

Mr. J. H. Riddle, recently a member of the staff of the Statistics Department of the Federal Reserve Bank of New York and an instructor at Columbia University, is now chief of the Statistics Section of the Secretary's Office at the Treasury Department.

Professor Robert Riegel, of the Wharton School of Finance and Commerce, is to give a course in insurance and one in statistics at the coming summer session of Northwestern University.

Mr. Harry S. Fischer has been placed in charge of the Bureau of Statistics of the New York Transit Commission.

Mr. W. A. Berridge, instructor and tutor in Economics at Harvard University, has won the first of three prizes awarded by the Pollak Foundation for Economic Research. "Unemployment and the Business Cycle" was the subject of his essay.

APPOINTMENTS ON COMMITTEES FOR 1922

At a meeting on February 16, 1922, the Board of Directors appointed the following committees:

Committee on Measurement of Employment: Mary Van Kleeck, Chairman; A. J. Altmeyer, C. B. Baldwin, W. A. Berridge, R. D. Cahn, F. E. Croxton, R. G. Hurlin, M. O. Lorenz, D. C. Lescohier, E. B. Patton, R. F. Phelps, W. H. Steiner, F. G. Tryon.

Committee on Business Research: F. Leslie Hayford, Chairman; Andrew H. Melville, First Vice-Chairman; W. L. Glenzing, Second Vice-Chairman; S. L. Andrew, L. P. Ayers, E. S. Bradford, R. C. Craig, C. S. Duncan, Earle Clark, L. K. Frank, J. E. Pogue, T. K. Stevenson, H. Parker Willis.

Committee on Institutional Statistics: H. M. Pollock, Chairman; Edith Abbott, Kate Halliday Claghorn, Edith M. Furbush, Joseph A. Hill, R. M. Woodbury.

Committee on Membership: Edwin W. Kopf, Chairman; Arthur R. Burnet, Robert E. Chaddock.

Committee on Program and Place of Next Annual Meeting: W. S. Rossiter, Chairman; L. P. Ayres, R. E. Chaddock, L. I. Dublin, W. F. Ogburn.

MEMBERS ELECTED SINCE FEBRUARY

Armour, H. Richmond, statistician, Pan-American Petroleum & Transport Co., New York City
Baird, Ralph P., Northwestern Bell Telephone Co., Omaha, Neb.
Bishop, Wilfred M., Statistical Dept., General Motors Corp., Detroit, Mich.
Dodge, Martin, Merchants Association of New York, New York City
Flinn, Harold M., American Tel. & Tel. Co., New York City
Forsberg, Allen B., Carroll College, Waukesha, Wis.
Fox, A. Manuel, lecturer, College of the City of New York, New York City
Goetz, Minetta-Marie, American Tel. & Tel. Co., New York City
Herendeen, Thomas G., American Tel. & Tel. Co., New York City
Hinkle, Helen H., American Tel. & Tel. Co., New York City
Jones, Mark M., 2702 Woolworth Bldg., New York City
Merchant, Ely O., G. H. Mead Co., Dayton, Ohio
Michener, S. M., American Tel. & Tel. Co., New York City
Oglesby, Earnest J., Dept. of Mathematics, New York Univeristy, New York City
Rankin, Francis B., American Tel. & Tel. Co., New York City
Rollins, Harold E., Asst. Statistician, Dennison Mfg. Co., Framingham, Mass.
Tanner, John B., president of Tanner-Gilman School, Inc., Chicago, Ill.
Weaver, Spencer E., graduate student, Columbia University, New York City

REVIEWS

Grundriss der Statistik, by Franz Zizek. Munich and Leipsic: Duncker and Humblot. 1921. viii, 470 pp.

Statistics as an academic discipline probably owes more to Germany than to any other country. The word, in the scholar's lingua franca of medieval Latin and later in the vulgar tongues when scholars condescended to employ them, though probably originating in Italy, was German in its early currency. For almost two hundred years, from the day of the Elzevir Republics until early in the nineteenth century, statistics held in German universities a position of honor and importance to which elsewhere it hardly attained. One of the two dominant currents of development throughout that period was so centered in the universities that it has been called German university statistics, a kind of descriptive political science exemplified by what the *Statesman's Year-Book* would be if stripped of its numerical or statistical statements.

During the following century, although the German conception of statistics changed into a closer resemblance to English political arithmetic, yet its hold on the German universities seems to have been little affected thereby. Naturally enough, although the content of statistical textbooks has changed, the literary output in Germany has continued unabated. Probably in the last generation it has equalled that of any two or three other countries. The present work challenges comparison with its predecessors and contemporaries in Germany, and its contemporaries (there are few predecessors) in other countries.

The most spacious survey of statistics ever conceived and carried well toward completion (I exclude Sinclair's *Statistical Account of Scotland*, as I do many sets of census volumes) is doubtless von Mayr's *Statistics and Social Science*, originally planned for two volumes but already filling three, although it has not yet touched the wide field of economic statistics. These three volumes, which have required more than a quarter of a century for their production, occupy nearly two thousand octavo pages. Other and briefer German surveys of this field are found in the fourth part of Conrad's *Outlines of Political Economy*, in Bleicher's *Statistics*, and in Schnapper-Arndt's *Social Statistics*. For England there is Giffen's *Statistics;* for the United States, Mayo-Smith's two volumes. These are the works with which the present publication naturally invites comparison. Other books like those of Newsholme, Bowley, Yule, King and Secrist represent a different view of statistics or are restricted to a relatively narrow field.

Professor Zizek has two objects in mind, one scientific, the other practical. The scientific object is to tie the theory more closely to the practice than previous writers have done. They have treated each branch of statistics by itself with little relation to coördinate branches or to the main trunk of theory; he writes both to prove and to illustrate the interrelations between one branch and another, and the dependence of any one branch upon certain general principles common to all. His practical object is to supply German students of the social sciences

with a brief and clear summary of statistical method, and of the main results secured by using this method in the study of mankind, particularly Germankind.

The book, accordingly, is in two parts: first, the theory and technique of statistics, or the general theory of statistical methods; and, second, material statistics, or the special theory of particular methods and a presentation in systematic fashion of the study's main results.

His general point of view appears in his discussion of mathematics and statistics. The preface states that his book, though touching on the fundamental principles of mathematical statistics, does not cover that field, which presupposes a knowledge of advanced mathematics not usually possessed by students of social sciences for whom he writes. In the body of the work he speaks of mathematical statistics as a special development within the field of statistical methods, applying the calculus of probabilities and the theory of errors. It is often contrasted with elementary statistics which uses only the simplest forms of computation. But such a contrast is one of technique, not of substance. The fundamental principles of mathematical statistics, such as the law of large numbers and the distinction between general causes and accidental disturbing causes, lie at the root also of elementary statistics. Both investigate the uniformities of statistical series, the distribution of single cases around an average, and the degree of correlation between several series. Mathematical statistics with its more refined methods can handle such problems with the greater precision. But the results of elementary statistics usually suffice for the investigations of sociology and economics, and in many such fields there is no need of going further: indeed, the conditions for resorting to mathematical statistics may be lacking. For these reasons the importance of mathematical statistics in the general field of statistical methods is theoretical rather than practical.

He ends the first part of the book with an answer to the question, Is the statistical method a species of induction? Eulenberg says yes; Tschuprow gives it an independent position coördinate with induction; Reichesberg, whom Zizek follows, maintains that induction infers the presence of a characteristic in all members of a group from its observed presence in many members, and thus generalizes. He also maintains that statistics refuses to make a similar assumption, asserting that by its principles no generalization from many members to the group is warranted and every member must be observed. The statistical method thus applies where it is inadmissible to infer inductively from the separate case to the whole group, or deductively from the whole group to the separate case. Reichesberg rightly maintains that the essential characteristic of the statistical method is the elimination of the unimportant, secondary, or individual causes through invoking the law of large numbers under which they will cancel.

To illustrate his handling of a specific statistical problem, I have chosen Professor Zizek's discussion of unemployment, the burden of which is so great as to call for statistical measurement. The condition of the labor market, the progress of an economic cycle, the amount of overpopulation, or the need for planning relief measures may be inferred from the number of the unemployed. This group should be analyzed by various characteristics such as sex and age, and by the duration of unemployment. The methods used in measuring unemployment are:

1. A census of the unemployed taken in connection with a census of population or of occupations. This has the advantage of completeness but the disadvantage of occurring only at long intervals and then perhaps at an unsatisfactory time.

2. A separate census of the unemployed taken at a period of depression or when means to care for unemployment are being considered.

3. Returns from trade unions giving the number of their members out of work or receiving out-of-work relief. The best measure of unemployment obtained from this source is the proportion of members out of work to all members. But unemployment depends upon the time one is out of work, and the best theoretical measure is the ratio between the number of idle days and the number of member days or possible labor days.

4. Those receiving public out-of-work relief are enumerated and the number reported. A distinction is drawn between those entirely out of work and those working on part time. The amount paid in relief and the cost of service are also given.

5. Employment agencies report the number of persons registering as in need of work. But the same person may register at several places, or when he registers may be at work of an unsatisfactory kind. On the other hand, when unemployment is greatest people may become hopeless and fail to register.

6. Statistics of paupers and of tramps throw some light upon the amount of unemployment.

7. Some cities maintain relief work for the unemployed and publish statistical information about them.

Professor Zizek's new book no doubt will prove of great value to German students of statistics. The first part dealing with the theory has a value less limited by lines of nationality. This part of the book might advantageously be translated and published for American students; or, better yet, a book might be prepared based upon this but substituting American material for the prevailing German data.

WALTER F. WILLCOX

Cornell University

Waste in Industry, the Report of the Committee on Elimination of Waste in Industry. New York: McGraw-Hill Book Company. 1921. xii, 409 pp.

The Federated American Engineering Societies came into being toward the end of 1920. One of the first acts of the president, Herbert Hoover, was to recommend a study into the restrictions and wastes in industry. Such a study was authorized by the executive board, and in January, 1921, fifteen engineers (whose principal interest was management engineering) were appointed as the Committee on Elimination of Waste in Industry. Two additional members were appointed later.

It was decided that the study should be in the nature of an assay or reconnaissance, carefully planned and rapidly executed. Both the findings and the method of investigation should be appraised in the light of this decision. In less

than five months six typical branches of industry had been assayed and a preliminary report rendered. The volume before us is the unanimous final report. It is a volume of extraordinary significance with respect to findings and method.

With respect to the findings, which the press has made familiar, the following summary table (p. 9) will suffice:

Industry studied	Responsibility[a] for waste assayed against		
	Management	Labor	Outside contacts[b]
	Per cent	Per cent	Per cent
Men's clothing mfg.	75	16	9
Building industry	65	21	14
Printing	63	28	9
Boot and shoe mfg.	73	11	16
Metal trades	81	9	10
Textile mfg.	50	10	40

[a] "Responsibility" as here used does not mean moral responsibility for the waste, but opportunity to remedy the conditions.
[b] Signifies the public, trade relations, etc.

The waste discovered in the six industries studied was attributed by the committee to: (1) Low production caused by faulty management of materials, plant, equipment, and men; (2) interrupted production caused by idle men, idle materials, idle plants, and idle equipment; (3) restricted production intentionally caused by owners, management, or labor; (4) lost production caused by ill health, physical defects, and industrial accidents. The point of view obviously was that of the engineer, *i. e.*, the waste due to failure to utilize fully the potential labor, material, and organization power in existing plants. No special inquiry was made into the possible waste from such sources as the social organization of industry or the over-equipment of an industry.

The method of investigation is of especial interest. The first step, the selection of the personnel of the committee, is logically a phase of the method, for apparently Mr. Hoover perceived that the only practicable method in detail for a rapid assay depended for its effectiveness upon the experience brought by the individual members of the committee to their task. The committee was therefore made up chiefly of management engineers who had had experience in developing the best management methods in individual plants, who had employed the methods of objective science in their practice in working out detail standards of good management, and who could bring these standards into the work of the committee as standards of appraisal of waste in the reconnaissance.

This point cannot be overemphasized. For the committee to employ the methods of objective science in its work was impossible in a study of five months —or five years, or fifty years. Study of industry on a large scale does not lend itself to such methods. The only possible method was to match observed performance against predetermined standards. The predetermined standards had to be as nearly as possible standards determined by previous studies in detail by the methods of objective science. The most signal individual achievement in the course of the investigation was Mr. Hoover's selection of the com-

mittee. For the purpose, it could not have been equaled by any other available group.

The committee proceeded first, bringing together individual past experiences, to construct an "Evaluation Sheet"—a code of standards. Standards were divided into three grand groups—Organization, Technical, and Utilization. These were weighted by the assignment of points totaling 100. Each of these groups was subdivided into sub-groups, each sub-group standard having a weighted value; and these sub-groups were again subdivided, each standard of a sub-sub-group having a weighted value. This scheme of weighted and valued standards was set up in the form of a "questionnaire"—not really a questionnaire, but a set of guide questions for field investigators.

Plants were then inspected with respect to each standard in the scheme, and with respect to each standard were given a value according to the degree the observed condition of management approached the value assigned the standard. The value of the standards were then summed up and the plant given a rating for Organization, Technical Methods, and Utilization, and these were summed up into a rating for the plant, all values being reduced to percentages. When appraising the plant with respect to each standard, the investigator appraised also the responsibility for the conditions indicating waste, whether attributable to (*i. e.*, remediable by) management, labor, or outside influences.

It is obvious, therefore, that the method is the method of empirical judgment with respect to the setting up of a code of standards, the appraisal of the condition found against a standard, the assigning of values, and the apportionment of responsibility. But the significant thing is that back of these standards and entering into their determination is a large amount of research into management methods according to genuinely scientific methods; and, further, that seventeen engineers, independent in their experiences, in some respects rivals in their theories, agreed upon the code of standards and upon the results of the investigation. The method of empirical judgment is not always to be sneered at; it depends upon by whom, and for what purpose, and under what circumstances it is employed, and how many independent competent observers are in agreement in the judgment. A skilled buyer of cattle on the hoof can "guess" within a few pounds the weight of a steer; a skilled timber cruiser can "guess" with surprising accuracy the millions of feet in a tract of timber. Some "guesses" have in addition to experience an ancestry of scientific methods of investigation.

The committee is under no illusions concerning its method and the result. We find (p. 118) the following: "We feel that the chief value of this field report evaluation sheet is to be found not in the results of this investigation, but in that it constitutes an important *beginning* out of which will be perfected a very powerful and very valuable instrument for investigation." Also: "We are fairly well satisfied that our evaluation sets forth the *comparative* wastefulness of the . . . plants with substantial accuracy . . . too much reliance should not be placed upon the absolute accuracy of the several evaluations."

Incidentally the book will be found to be one of the best books of reference, possibly one of the best texts, for the teaching of management.

H. S. Person

Taylor Society, New York

Cycles of Prosperity and Depression in the United States, Great Britain, and Germany: A Study of Monthly Data, 1902–1908, by Alvin Harvey Hansen. (University of Wisconsin Studies in the Social Sciences and History, No. 5.) Madison. 1921. 112 pp.

Professor Hansen has developed an interesting variant of the statistical attack upon business cycles. He confines himself to the study of a single cycle, collects all the statistical series covering it that are readily available in monthly form, eliminates the secular trends and seasonal oscillations, reduces the "cyclical fluctuations" to terms of their standard deviations, and, finally, computes coefficients of correlation among the series in this refined form. The influence of Professor Warren Persons upon the technique of the investigation is obvious.

The first result of the work is to divide the 23 American series dealt with into three groups according to the time relations among their cyclical fluctuations:

> The Investment Group includes series that anticipate general prosperity or depression and are related to the investment market. The Industrial Group includes those series which constitute the very essence and substance of prosperity and depression; it is the touchstone, the barometer of good and bad times. The Banking Group represents the monetary and credit facilities, the tools and instruments of the modern business mechanism. (Pp. 22–23.)

From each of these groups Professor Hansen selects from three to five series that are substantially synchronous in their oscillations, and makes them into what he calls Investment, Industrial, and Banking "Composites." Taking the highest coefficient of correlation obtained from computations made for varying lags as his base line, he finds that the Banking Composite (the revenues, deposits, and loans of New York clearing-house banks, plus call-loan rates) precedes by twelve months the Investment Composite (prices of 10 investment and 40 railroad stocks, shares sold in New York, and liabilities of business failures), while the latter precedes by eight months the Industrial Composite (commodity prices, pig iron output, railroad gross earnings, imports and immigration).

Next Professor Hansen makes Banking, Investment, and Industrial Composites for Great Britain and Germany. He finds that the American Banking Composite precedes the European series slightly; that there is very close correlation between the American and British but not between the American and German or the British and German Investment Composites, and that the Industrial Composites in the three countries move in close agreement with each other. He does not inquire whether the relations found among the cyclical fluctuations of his three composites in the United States hold among the three composites in Great Britain and among the three in Germany.

Turning, finally, to "The Theory of Prosperity Cycles," Professor Hansen asks whether the trouble that culminates in crises begins with a decline in the demand for consumers' goods, or whether "the initial diminution of demand is on the part of business men for producers' goods." To decide this issue he compares the fluctuations in the prices of consumers' and producers' goods in the United States from 1902 to 1908. For consumers' goods he averages the Bureau of Labor Statistics group index numbers of food, clothing, and house furnishings at wholesale, and for producers' goods he makes similar averages from the group

index numbers of metals and implements and lumber and building materials. As a further test he compiles special German index numbers including 16 producers' and 14 consumers' commodities. The results are clear: "In both countries the prices of consumers' goods begin to decline about seven months after the decline in the prices of producers' goods." (P. 98.) Nor does he find any evidence "that the prices of producers' goods fall because of a diminution in the *rate of increase* in the prices of consumers' goods." (P. 102.) "In fact, so far as the United States is concerned, the rate of increase appears if anything to increase after the fall in the prices of producers' goods," and in Germany consumers' goods rose as rapidly in April–August, 1907, as in June–October, 1906. "In short," he concludes, "the theories emphasizing consumers' demands do not appear to harmonize with the statistical facts." (P. 103.)

The "fundamental cause of the business cycle," in Professor Hansen's view, lies in the economic effects produced by the extension of bank credit:

> The issuance of bank credit simply redistributes purchasing power, reducing the real purchasing power of income receivers generally, and increasing the purchasing power of entrepreneurs able to secure bank credit. It is this redistribution of purchasing power, accomplished through the instrumentality of banking institutions, that changes demand, upsets prices, affects the profit margin, and therefore production. . . . The magnetic force which draws out the extensible bank credit is the entrepreneur's anticipation of profit. . . . So long as bank credit continues to be capable of further expansion, prices continue to rise. This upward movement comes to a close only when bank credit can no longer be further extended for the reason that it has already reached the limit of banking safety. (Pp. 106–7.)

This analysis is confirmed according to Professor Hansen by his statistical results. For, as said above, the earliest movements in the business cycle are those of the Banking Composite.

Such is the gist of a little book which every one concerned with the subject will find suggestive and inconclusive. We may hope that Professor Hansen plans to rewrite his chapters on a more liberal scale and with a more critical treatment of his data. It is dangerous to base broad conclusions on the study of a single cycle. For example, a comparison of the price fluctuations of consumers' and producers' goods in 1919–20 might yield results very different from those which Professor Hansen (and the present reviewer) have drawn from 1906–07. Further, in dealing with this topic the investigator should scrutinize his material narrowly to see whether his list of consumers' goods does not contain a preponderance of farm products, and his list of producers' goods a preponderance of mineral and forest products. If such is the case, the results may not justify the construction Professor Hansen puts on them. Once again, if Professor Hansen knew the erratic way in which the import and export statistics of the United States have been compiled in the past he would not have wasted his time in computing coefficients of correlation based on the monthly returns. Finally, Professor Hansen's three "Composites" represent a geographical difference as well as the difference between banking, investment, and industry. Every series in the Banking Composite reflects conditions in the great clearing-house banks of New York City, and every series in the Investment Composite, except "liabilities of business failures," represents conditions on the New York Stock Exchange.

His Industrial Composite, on the other hand, represents conditions in the country at large. Hence the conclusions which his figures justify are not conclusions about the precedence of banking over investment and investment over industry, but are at best conclusions about the precedence of banking in the financial center over investment in that center, and the precedence of investment in the financial center over business operations at all ports of entry and throughout the interior.

WESLEY C. MITCHELL

National Bureau of Economic Research

General Accident Statistics for Wisconsin, Industrial Commission of Wisconsin. Madison. 1921. 124 pp.

Wisconsin was one of the earliest states to adopt Workmen's Compensation, its act dating from 1911. The Industrial Commission of Wisconsin has always been distinguished by ability, and it is one of the few administrative boards in the United States which has consistently maintained a competent statistical department. Wisconsin, accordingly, holds a place of well-deserved leadership in the output of accident statistics.

The present document is the first comprehensive tabulation of work injuries issued by the Industrial Commission since 1915. It covers all compensable injuries adjudicated in the period 1915–20, but the more detailed tables are limited to cases settled in 1920. The publication is a special number of the *Wisconsin Safety Review*, and gives particular attention to *cause* in correlation with *severity* of injury. There are tables of cause and severity for all industries, 1915–20, for all industries, 1920, and for metal working, paper making, logging and lumbering, mining and quarrying, and building industries, 1920. The classifications and scheme of tabulation in these tables are those recommended by the statistical committee of the International Association of Industrial Accident Boards and Commissions, and the work is admirably done. There are also tables of compensation cost by severity of injury, part of body and duration of disability, and a frequency distribution of the weekly earnings of injured workmen. Especially useful are the detailed exhibits of permanent partial disabilities not amounting to loss or loss of use of members (Table XI), and of the healing period, or duration of temporary total disability, in connection with permanent partial disabilities (Tables XIII and XIV).

Of special interest and value are the estimates of relative accident frequency and of total accident severity. Relative frequency was plotted from the reported number of compensable injuries and an index number of employees obtained from reports to the employment division of the Industrial Commission. The curve shows a sharp rise of accident frequency in 1916, another in 1918, and a third in 1920, with a slight dip in 1917, and a marked dip in 1919. It is notable that the low point of 1919 was 150 as compared with 115 in 1915. Total severity of industrial injuries is expressed in days lost by the use of standard weights for deaths and permanent disabilities recommended by the International Association of Industrial Accident Boards and Commissions.

Total severity is a ready index of the relative importance of specific causes of injury, and the severity rate, obtained by comparing total severity with number of employees, is the best possible index of the accident hazard of specific industries.

The format of this document is good, the table headings are clear, and the several charts and graphs are really useful. No time or space has been wasted upon irrelevant matter, nor upon beautiful but meaningless designs. The only criticism to be offered is that much highly useful material was omitted. Considerations of expense, enforced by inadequate appropriations, doubtless caused the omissions, yet the added cost would amount at most to a few thousand dollars per annum.

The most serious omission is the failure to give exposures in correlation with the number and severity of injuries. The Industrial Commission has jurisdiction over both insured and uninsured employers and is in position to obtain at least the pay-roll of every employer subject to compensation. Employers who are permitted to carry their own risk can be required to report pay-rolls in such detail as the commission may prescribe, and insurance carriers can be compelled to report pay-rolls by individual risks in Wisconsin as well as in Pennsylvania. The pay-roll is not the best basis for computing accident severity rates, but it is the only basis attainable in any jurisdiction, American or foreign. Total pay-roll, divided by the average weekly wage obtained from accident statistics, will even give a closer approximation to the actual number of employees exposed than can ever be obtained from the employers' reports of the numbers employed.

The industry groups in this document are too few and too comprehensive—logging, saw milling and furniture manufacturing, *e. g.*, are by no means a homogeneous aggregate. It is unfortunate too that the industry tables cover only a single year; the five year period would give a broader exposure and more representative averages. Lastly, there should be far more detail as to the *nature* in correlation with severity of injuries.

With all these sins of omission the publication under review is much the best extant compilation of accident statistics for a large industrial community. *General Accident Statistics* reflects great credit upon the Industrial Commission and its statistician.

E. H. Downey

Pennsylvania State Workmen's Compensation Commission

Family Budgets of American Wage-Earners: A Critical Analysis. Research Report No. 41, September, 1921. National Industrial Conference Board. New York: The Century Company. 97 pp.

This report presents a brief summary of facts about nearly all the important budget studies of wage-earners' families in America. Readers are already familiar with summaries of budgets published by the Bureau of Applied Economics. This study is somewhat more analytically critical, however, and less a detailed presentation by items of the different budget studies. The facts reviewed are incomes, expenditures, percentages spent for food, clothing, rent, fuel and light,

and sundries; sizes of families, income classes, dates, places, investigators, etc., for the various investigations of the last quarter of a century. In addition there is a short history of the use of family budgets in wage disputes. Woven around the facts and their classification are interpretive estimates of their value and use.

In popular usage there is much confusion about the cost of living. The report calls attention to the difference between the change in the cost of living and what the cost of living is. It also differentiates the minimum subsistence level from the minimum comfort level, a differentiation frequently not made in wage adjustments. The report also attempts to show the difference between budget studies which are simply records of actual expenditures and budget studies that are estimates of standards of what ought to be spent. These two types of budgets are quite different things, serving different purposes, although they are interrelated and a good estimate of a standard can be made only after a study of actual expenditures. Obviously, the two types of budgets may be made at either the minimum subsistence level or the minimum comfort level.

It seems to me that this last differentiation is not always kept clearly in mind by the author, and that this is one reason for the harsher criticism of the minimum comfort budgets. The author recognizes in the conclusion of Chapter II that estimates of standards at the subsistence level are based on actual records, but seems not to recognize this basis as true at the comfort level discussed in Chapter III. "In the present chapter are reviewed the best known of the attempts to estimate the cost of living made without collecting incomes and expenditures from actual families." (Page 33.) Seldom before has there been so much good material on "incomes and expenditures from actual families" as was collected by the United States Bureau of Labor Statistics. Most of the data were for the minimum comfort level and served as a basis for estimates of standards made at this level. Also, many estimates reviewed in Chapter III were based on actual records of expenditure. Again, in estimating the minimum comfort budgets: "The minimum comfort budgets on the other hand represent ideal conditions. . . ." (Page 50.) The minimum comfort budgets are simply standard estimates at a higher level than the standard estimates at the subsistence level, and would not be admitted by the investigators who made them or by the wage-earners as representing ideal conditions.

In Chapter IV the author presents research to show that the size of the family used in estimates of standard budgets—five persons—is not typical of the country or locality. This research on the actual size of the family is interesting but, it is thought, not particularly relevant to setting a standard. The average size of the family in a particular locality may be less than five, but a standard would hardly be drawn up for less than five. Public policy would not sanction a smaller family, for two children must grow up to replace the parents, else the population decreases; and since the chances of death for children are great, provision must be made for more than two children. Mr. Rowntree's researches on this point show a practical justification for this procedure. The following quotation seems to be another indication of a possible confusion of the actual and the standard. "Instead a family of five . . . was taken as typical of the American wage-earner." (Page 71.) I doubt if the author could cite but few if any instances where the

framers of standard budgets claimed that the family of five was taken as "typical." It is taken as a minimum standard but not as actual or typical.

Frequently the point is made in the report that families studied in surveys were selected and not chosen at random. The idea that selection prevents representativeness and that purely random selection is a desideratum needs qualification. A mere haphazard choice of families would itself turn out to be a selection; in reality the samples must be selected in order to yield the desired representativeness. And if the purpose of a survey is to determine a standard, cases are selected to throw light on the standard. If a standard is being set up for families without boarders, why collect data on boarders?

The report is scholarly. There are abundant footnotes. The facts and data are accurately listed. There is evidence of carefulness. Any departure from science, rather, any bias in the report, would show only in the interpretations and in the selection of material to be presented. For instance, this report of the National Industrial Conference Board nowhere presents a budget in detail showing how many shoes or dresses or hats are bought, or how much is spent for recreation or for doctors. The method here is to present only such summaries as "40 per cent of the income is spent for food." This procedure is, of course, quite within the right of the authors, and to have done otherwise might have marred the nature of the study or not fitted in with its scope. This method of presentation leaves the reader less impressed with the human significance of the standard of living than if, for instance, the report read,"the budget allowed the purchase of one straw hat every other year at $2." In the analysis and collection of budgets by organizations supported by wage-earners, budgets are given by items because these organizations wish to get across the human meaning of the budget. Different methods of presentation leave various effects as truly as do data and facts. For instance, what the National Industrial Conference Board calls the "American minimum," the wage-earner will call "bare subsistence." In any statistical work there is always room for the subjective; as a matter of fact, it is very difficult to make any interpretation free from bias. This report, as reports go on controversial and emotional issues, is exceptionally free from subjective distortion, and would be quite generally rated as a clear, useful presentation.

WILLIAM F. OGBURN

Farming Costs, by C. S. Orwin. Oxford University Press. 1921. 141 pp.

This little book, a revision of an earlier work entitled *The Determination of Farming Costs*, consists essentially of an outline of a method by which cost accounting can be applied to agricultural operations, a brief but penetrating discussion of the fundamental problems that arise in this field of cost analysis, and a statement of the principal results to be obtained from such accounting. It appears to be based largely upon investigations conducted by the Institute for Research in Agricultural Economics, of which Mr. Orwin is director.

In the introductory chapter attention is called to the more patent advantages of stock-keeping and costing in the conduct of a manufacturing establishment, and it is pointed out that as yet little effort has been made to place farm manage-

ment upon a similar statistical basis. In this connection the fact that the determination of costs in agriculture is a problem involving peculiar difficulties is rightly emphasized, and no unreasonable claims are made with respect to the possible results to be obtained from such work. The author does not suggest that every small farmer should install an elaborate system of accounts. He admits the propriety of the view that in many cases "managerial functions can be exercised most profitably in the field." On the other hand, he insists that a thorough analysis of farm costs in even a few representative cases should furnish valuable standards for comparative purposes and should facilitate the solution of underlying agricultural problems.

In beginning his discussion of procedure Mr. Orwin first contrasts the "synthetic" and "analytical" methods of approach, and very properly decides that the only cost data of significant value for managerial purposes are the *actual* costs—as nearly as they can be ascertained—and not hypothetical costs based upon selling prices adjusted with reference to an estimated rate of return upon investment. It is refreshing to find this clear-cut stand against the inclusion of interest or other income elements in a calculation of cost from the point of view of the individual establishment or business. Here the author also takes occasion to repudiate price-fixing as the primary object of cost accounting. He avers that it is the essential function of such accounting "to provide an analysis of cost so that waste may be detected and so that the manager may be able to consider means for effecting economies in production by an examination of cost at all stages." Such conservative views are a pleasing contrast to the pretensions of the typical cost enthusiast.

The entire book, in fact, is especially noteworthy because of its many excellencies with regard to points of view applicable to all branches of cost accounting and the acute observations it contains on fundamental questions of principle arising particularly in the determination of farming costs. Mr. Orwin throughout shows keen appreciation of crucial problems and a willingness to face them squarely. His work is a consideration of underlying theories even more than it is an explanation of practical procedures or a compilation of statistics.

In outlining a procedure for the determination of agricultural costs the author discusses the principal books, records, and classifications which he believes should be employed. He describes various "stock books," "implement and machinery records," "time sheets," etc. For purposes of cost classification he decides upon the *field* rather than the *crop* or the *operation* as the most important primary accounting unit, giving as a principal reason for the adoption of this plan the statement that "there are few crops which do not inherit some benefit from their predecessors, or which do not hand on some unexhausted value to their successors." Thus the costs of labor, fertilizer, seed, etc., are charged to the particular field account, an appropriate part thereof being later transferred to an intermediate "dead stock" account when a crop is harvested. The principal classifications for live stock are also discussed, and it is suggested that the cost of fodder consumed should be divided between the live stock and the fertilizer accounts on the basis of the value of food residues as worked out by certain standard authorities. Evidently, arbitraries must be used in such procedures to a

serious extent, and hence a mild skepticism as to the validity of the resulting costs is perhaps pardonable. In the opinion of the reviewer there is much to be said for a system for the ordinary case which ignores the cost of fertilizer produced on the farm, and does not call for an apportionment of labor, fertilizer, and other costs between a succession of crops.

Numerous forms are exhibited. Most of these would require modification for use by the American farmer. The implement register shown on pages 20–21 is cumbersome and inadequate. The use of a series of year columns, in each of which is shown the balance of each class of equipment after depreciation for the preceding period has been deducted, is quite unnecessary. Such a register should show the date of purchase, the cost, the estimated service life and depreciation rate, and, ultimately, the date of sale or abandonment and the sale or salvage value. The estimated accrued depreciation can then be accumulated in a controlling contra account; and no reconciliation with respect to the implement book is required until a unit is finally disposed of. In this connection Mr. Orwin's "limit of depreciation" theory may be said to be somewhat unreasonable. The farm manager should decide upon a service life and then prorate the total depreciation evenly over this period. To fix in advance a figure beyond which it is assumed there will be no depreciation, and which will be reached perhaps years before the end of the estimated service life, is surely a questionable procedure.

Chapter III, in which a series of difficult and disputed questions are considered, is the most interesting part of the book. The first of these questions is valuation. Mr. Orwin insists that actual cost is the only proper basis for the valuation of unsold produce, live stock, and other items. He vigorously denies the validity of the market as a valuation test. From the standpoint of the cost accountant this position is doubtless quite reasonable, but there is much to be said on the other side as far as general accounting and the preparation of the income sheet and statement of financial condition are concerned. Our Treasury Department now permits farmers to value unsold produce for income tax purposes at selling price less estimated marketing costs, or in other words, to "take their profits" in the year in which the crop is produced rather than in the year in which it is marketed, assuming the two to be different; and in view of the difficulties in the way of accurate costing for the average farmer, and the especial importance of the market in the case of staple farm products as an indication of true financial position, this ruling is to be commended.

Mr. Orwin insists on the importance of recognizing depreciation in the case of draft animals, although he apparently denies that dairy stock can so decline in value. His suggestion that the cost of pedigreed stock should be divided between ordinary cost and pedigree value (a value somewhat analogous to that of patents) is interesting but rather bizarre.

The discussion of the valuation of intermediate products (pp. 43–46) is especially good. The author points out that the farmer does not sell oats and hay to his live stock and that he is not justified in assuming that any such transaction occurs. It is in this case that valuation on any but a cost basis is especially questionable, and Mr. Orwin makes the most of the opportunity to demonstrate this fact. Three ways of dividing "joint" costs are mentioned. One possibility

is a separation on the basis of the proportion indicated by the market prices of the joint products; relative "food values" give a basis for a second method; the selection of a main product and the use of any sales of the by-product as a reduction in the cost of the principal result is a third plan, and the one now favored by the author.

Mr. Orwin suggests that general or "establishment" costs should be apportioned on the basis of the sum of manual, horse, and tractor "labor" charges. Such apportionment, he feels, is preferable to none. A curious definition of rent as interest on capital may be noted in this connection (pp. 55–56).

In Chapters IV and V the results to be obtained from cost analysis on the farm are stressed and a considerable number of tables based on actual investigations are exhibited. These show unit costs of horse labor, mechanical power, etc., and of crops of various kinds, for certain cases which have been studied by the Institute. The importance of the more general data which may be derived is emphasized. Tables indicating output per man, per acre, etc., are presented. There is some discussion of the fundamental problem of combining proportions. Data are offered, for example, which suggest that the number of laborers and the output per hundred acres vary inversely with the size of the farm, and that the output per man varies directly with the holding. These tables, it may be noted, are not always arranged to the best advantage, and appear to be seriously inaccurate. In the one on page 101, for example, the designation "total" is attached to the footings, but the last two are clearly intended to be averages. Further, the arithmetical averages of the amounts shown in these last two columns are 837⅜ and 273⅛ rather than 814 and 287 respectively—the numbers given. Similarly, on pages 102 and 103, where the term "average" is used several times, the figure given is in no case even an approximate average of the various amounts involved. The discrepancies are so serious that it seems evident that Mr. Orwin must have some special method of calculation, not properly known as averaging, and with the mysteries of which he does not acquaint the reader.

Other problems mentioned upon which the writer believes light may be thrown by means of data drawn from accounts are the relation of labor cost to earnings per man and the cost of living, and the distribution of the net returns of farming among tenant, laborer, and landlord. A study tending to show the extent to which the small farmer can profitably use machinery would have been interesting. There is some evidence that American farmers are loading the small farm with more equipment than it can economically support.

The very extensive bibliography appended is a valuable feature of the book.

Mr. Orwin, despite his conservatism, is perhaps unduly optimistic with respect to the development of accounting and the use of business methods in agriculture. One finds it hard to picture the typical Michigan farmer, for example, attempting to introduce any system of accounts even remotely approaching the rather elaborate scheme suggested in this book; and the reviewer feels that it is very doubtful if it would be expedient for him to make the attempt. The difficulties in the way are inherent and serious. Possibly something can be done in this direction if the farmer's wife can be induced to add bookkeeping to her already too numerous tasks.

W. A. Paton

University of Michigan

Army Anthropology (Part I of Vol. 15: Statistics: The Medical Department of the United States Army in the World War), prepared under the direction of M. W. Ireland, Surgeon-General of the Army, by Charles B. Davenport and Albert G. Love. Washington. 1921. 635 pp.

This volume presents the anthropological data on recruits in the World War and is a companion volume to that entitled *Defects Found in Drafted Men*, prepared by the same authors in 1920 for the Surgeon-General's Office, War Department. The volume is a very complete analysis of the anthropological measurements on 1,000,000 recruits, on 100,000 men at demobilization, and on a large number of men showing certain physical defects.

The height, weight, and chest circumference were taken on the first 1,000,000 recruits. The mean values for the army as a whole and for groups of men from various sections of the country were compared with the Civil War records. As the authors point out, these facts cannot be used as an indication of the change of build in American young men because of the great influence of subsequent immigration. Comparison is also made between recruits from the individual states of the United States and also from the various sections of the country as characterized by occupation or type of population. This may possibly serve as a background for studying and perhaps understanding the variation from the mean for recruits from various sections. Comparison between the recruits at mobilization and at demobilization showed an increase in all three measurements over the latter group.

The most interesting comparisons, however, are those made between men of different nationalities—English, French, German, Hebrew, Irish, Italian, Polish, and Scotch. The tallest race are the Scotch; their mean height (67.93 inches) is almost 3 inches greater than that of the shortest race, the Italians (65.03 inches). The standard deviation for each nationality was about $2^1/_2$ inches. The mean weight ranged from 148.20 pounds for the Germans down to 137.85 pounds for the Hebrews. The significant fact was found that the Mediterranean races and the Hebrews have a greater chest girth in comparison with their height and with their weight than do the Nordic races. This may help to explain the very favorable condition of vigor of these two races.

The three measurements of height, weight, and chest circumference are important for selecting recruits for the army, but more important still, in the opinion of the authors, is Quetelet's height weight index, $\frac{\text{Wt}\times 1000}{\text{Ht}^2}$. This index "tells us something about the physical constitution of a man, and, by implication and as a result of experience, also something of his ability to withstand the stress of warfare. . . . In fact, it is not too much to say that the principal reason for taking weight in connection with height is to secure a numerical statement of the build as a first means of deciding upon the acceptance or rejection of the recruit for military service." This index, however, ranges from 36.5 for the short men to 28.6 for the tall men, because the weight does not increase at so great a rate as the height squared. Just what does this index indicate, and what is its range of variation compatible with good constitution? For men under 70 inches the index for the World War veterans, because of their

greater relative weight, was higher than for the Civil War soldiers, and the authors conclude that the soldiers in 1919 were more robust.

But what are the limits of this beneficial extra weight? In studying men from various states and sections of the country and men with specific impairments, the data are not subdivided by age, but the index is computed for the group as a whole. If we may still assume that a higher index indicates a better constitution, we find that men with flat feet, varicose veins, hypertrophic tonsils have a better constitution than the recruits for the World War. Obviously, there are some limitations to the use of this index. Too much is claimed for it. A man of any height with corresponding average weight may be said to have a good build, but it is yet to be proved that his constitution and power of resistance are necessarily good. The results must be interpreted with great caution.

The authors use another index for robustness known as Pignet's formula [Height in cm − (chest in cm + wt in kg)]. The lower the index the better the constitution. This formula is founded on Pignet's argument that chest girth increases with height and also with weight, that the three quantities increase in such a way that in the normal person the index obtained by applying the formula will be a constant. We know that these measurements give wide variations. In fact, on these data the variations are so great that 65 per cent of the recruits over 5 ft. 7 inches do not measure up any higher than the majority of the groups showing impairments.

Eighteen special anthropologic measurements were taken on 100,000 men at demobilization, and comparison is made between the white and negro troops. Though the average height of both groups is about the same, the average weight is a little higher for the negroes. In the main, the negroes have relatively longer appendages, shorter trunk, head, and neck, broader shoulders, narrower pelvis, and greater girth of neck and length of thigh and calf than the white troops. The white troops seem more powerfully developed than the negro in the chest and less powerfully developed from the pelvis down.

The second section of this volume deals with the measurements of height, weight, and chest circumference and the interrelation of these three measurements of recruits found with various impairments including organic, functional, and physical abnormalities. The possible reasons for deviation from the normal are fully discussed. In studying these statistics it is important to consider the race in relation to the disease. For example, the group having myopia shows a relatively low mean stature as compared with other impairment groups. This is not because short stature causes myopia, but rather because this group is largely composed of Polish Jews whose mean stature is low even among the normal population. This combination of two dissimilar classes gives results with high variability. Where size and defect interact as cause and effect, the coefficient of variability is low. This must be taken into account in studying these diseases in connection with bodily measurements.

The mean values of the measurements on these groups cannot, however, be used as criteria of all groups of persons showing these impairments, because the recruits here reported on had been passed by local draft boards and were therefore highly selected, probably representing the best of that impairment class.

This volume is an excellent handbook. The data are clearly presented and carefully analyzed. For every measurement taken there are tables giving the comparisons between groups from individual states and sections of the country, and between recruits of various nationalities. Charts and graphs bring out clearly the points of interest. For the student who wishes to study in even greater detail the data presented, there are tables of correlation between many pairs of measurements. A definite and valuable contribution has been made to the anthropologic data on young American men.

MARGARET E. GANTT

Monetary Policy, Being the Report of a Sub-Committee on Currency and the Gold Standard, by J. H. Clapham, C. W. Guilleband, F. Lavington, D. H. Robertson. London: P. S. King & Son. 1921. 75 pp.

The currency disorder now prevailing in what was formerly the "gold standard world" has opened another era of discussion concerning monetary problems. In Great Britain, where the currency has not depreciated beyond the hope of redemption, the discussion has already led to the collection of information and the consideration of alternative policies. This pamphlet, the report of a sub-committee appointed by the British Association for the Advancement of Science, presents the relevant statistical data for the period from 1914 to 1921, woven together by comments which indicate the significance of the changes in such matters as the volume of currency, the national debt, the balance of foreign trade, and the level of prices. On the basis of this information the report then considers two general questions: first, whether the level of prices most conducive to the general welfare would be higher or lower than the post-war level, and by how much; and, second, the desirability of a return to an effective gold standard.

In the consideration of the second question the report is most suggestive. While the restoration of the old gold standard is not viewed as the final goal of monetary policy, yet it is regarded "as a respectable interim measure the accomplishment of which would be worth some trouble and inconvenience." The possibility of reëstablishing specie redemption in England seems to depend upon the relative movements of the price levels in the United States and in England. The passing of the present business depression, it is held, will furnish an opportunity for pursuing a policy which might bring English prices nearer to the gold price-level. With the return of prosperity and the increase of prices which may be expected to accompany it, the policy recommended is the restriction of the rise in English prices by moderating the expansion of bank currency. If, during the same period, the United States made full use of the available bank credit, the gold price-level would rapidly advance, and "the gap between the American and the English price-levels would, for the time being, be at least partially closed." The adoption of such policy, it is recognized, would require of borrowers in England, both private and public, an unaccustomed restraint in the use of bank credit; and, further, the success of the policy would depend largely upon the rediscount policies of the Federal Reserve Banks. The conclusion is, apparently, that if the United States will indulge sufficiently in a differential inflation, then England may be able to resume specie payments.

The argument in favor of restraining the boom and controlling the expansion of credit as a means of restoring the gold standard is put very briefly. The member of the committee who wrote this portion of the report, Mr. Robertson, is to deal more fully with the proposal in a forthcoming book.

W. W. STEWART

Forty-fifth Annual Report of Criminal Statistics of Canada, for the Year Ended September 30, 1920. Ottawa: F. A. Acland. 1921. xviii, 326 pp.

An inhabitant of the United States has only to read this report to be thoroughly ashamed of the backward position of his own country in the collection of criminal statistics. This report, printed in both French and English, contains the kind of information that ought to be readily available for the student and the statesman concerning crimes and criminals in the United States. When one pauses to consider the fact that the United States publishes no judicial criminal statistics and has not published any prison criminal statistics of more recent date than 1910, one can but marvel that Canada is now publishing its forty-fifth annual report.

À propos of the present vague discussion in the United States over the so-called "crime wave," it is refreshing to know what is actually happening in Canada. There was an increase in convictions in 1920 over those in 1919 of 25.14 per cent; but the increase is almost entirely in non-indictable offenses. The increase in indictable offenses was but 0.25 per cent, the lowest ratio of increase since 1917. Serious crimes have, therefore, received a decided check. The percentage that juvenile conviction made of the total convictions has also fallen. Prior to 1919 this percentage had been increasing steadily for a period of fourteen years.

The report throws considerable light on the efficiency of the machinery of justice. For the first time the report contains police statistics, covering eighty-eight towns and cities. From these, it appears that 183,126 offenses were known to the police and that 161,468 persons were arrested or summoned to stand trial, a proportion that is surely commendable. However, the ratio of arrests to known offenses is not so high for certain crimes that are now puzzling the police in the United States. For example, there were 5,655 burglaries, house, and shop breakings, and only 2,317 arrests; 663 highway robberies were reported, yet the courts dealt with but 332. Encouraging, however, is the fact that the police recovered 3,534 of 3,682 automobiles that were reported stolen. Turning to the work of the courts we find that the percentage of convictions for indictable offenses has been steadily increasing for a long period of years. It is now 79.8 per cent.

Interesting too is the fact that the report shows a steady increase in the use of fines and the suspended sentence, while, on the other hand, sentences to terms of imprisonment have decreased, especially those sentences of five years and over. This shift away from severity of punishment has not brought any noticeable increase in the number of habitual criminals. Indeed, the percentage of those convicted two or more times has remained nearly fixed at fifteen for the last thirty years.

Who, according to the report, are the criminals? In the first place they are mostly men, the figures showing a ratio of 10 males to 1 female for indictable offenses and of about 16 males to 1 female for non-indictable offenses. The proportion of males to females is, moreover, increasing for both classes of offenses. The criminals come from the cities. In 1911 the urban population constituted 42 per cent of the total population of Canada, but the cities and towns produced 87.7 per cent of those convicted of indictable offenses. A little over one half of those convicted of indictable offenses are native-born Canadians. Those who claimed a religious affiliation of any kind, with the exception of those of Jewish connections, were represented in the criminals convicted of indictable offenses by a smaller percentage than the members of their respective denominations were represented in the general population. Probably the Jews suffered in this comparison on account of the fact that a Jew was no doubt thought to belong to a synagogue because he was a Jew.

The report seems weak with respect to comparisons of the various groups of offenders with the corresponding groups in the general population. The country of birth is given for the offenders, but we are not told anything about the foreign-born in Canada. We learn the occupations of the convicted group, but do not know the occupational groupings of the general population. The same thing is true with regard to the educational status: we have it for the convicted but not for the country. Another defect is that too little is said of those convicted of non-indictable offenses. No doubt it is much more difficult to obtain the social facts concerning this group of offenders, but it would be well worth the additional effort. Taken as a whole the report is, nevertheless, an excellent summary, and we who are interested in the development of this branch of statistics in the United States can but regard it as the goal of our own endeavors.

LOUIS N. ROBINSON

Swarthmore, Pa.

The Unemployment Problem. National Industrial Conference Board, Research Report Number 43. New York: Scribners. 1922. 91 pp.

This report presents, in handy summary form, a compilation of the results of the more important inquiries so far made in this country concerning the extent, distribution, and causes of unemployment, together with a somewhat uncritical discussion of these results and of suggested remedies. The presentation and discussion of the evidence—statistical, for the most part—as to the extent and causes of unemployment occupy about two thirds of the report, the remainder being devoted to a short preliminary discussion of the meaning and significance of unemployment, and to a brief but systematic résumé of suggested remedies.

The Conference Board has here a compilation and discussion of statistical material already published, not a report of a first-hand investigation. There are, indeed, a few pages in which the Board essays to "give an intimate view of the existing employment situation." In these few pages are set forth the replies elicited by one of the Board's circular letters and reporting in very general terms the unemployment situation—estimated number unemployed, employed part

time, etc.—in different parts of the United States in the summer of 1921. For example: "In Connecticut, 120,000 persons were estimated to be idle on August 15, 1921. This represented a decline of 51 per cent in employment since July 1, 1920." This section of the report is, in the reviewer's opinion, the least valuable part of the book.

The report is valuable chiefly because it sets forth in convenient form the results of first-hand, official inquiries. The Board's chief reliance is upon the fairly well-known Massachusetts and New York reports. In addition, the more fragmentary records from Arkansas, New Hampshire, New Jersey, Ohio, and Wisconsin are drawn upon. The figures collected by the Federal Bureau of Labor Statistics, the United States Employment Service, and the Bureau of the Census are, naturally, referred to. The only unofficial investigation whose results are presented in the Board's report is the one conducted by the Metropolitan Life Insurance Company in 1915 to supplement the inquiry made the same year by the Bureau of Labor Statistics. The study made by Hornell N. Hart of "Fluctuations in Employment in Cities of the United States, 1902 to 1917" is not mentioned.

In its preliminary discussion of the problem the Board makes the usual distinction between "idleness" and "unemployment," the latter being identified as merely one phase of the former. If the reason that a person is not at work is simply that he does not want to work, he is voluntarily idle, not "unemployed"; if he is not working because he cannot find a job he is involuntarily idle, and "unemployed." Reasonable as this may seem to be as an academic classification, there are two serious practical difficulties involved in its application, neither of which the Conference Board escapes in its report. The first difficulty is that the definition is not complete until it is decided whether a person who wants to work at his regular craft, but not being able to get that particular work remains "idle" because he is unwilling to work at such other work as he may find available, possibly at a wage lower than his customary one—whether such a person is or is not "unemployed." The Board does not touch upon this dilemma and, presumably, would say that a person in the predicament just stated is idle but not unemployed. The second difficulty is probably more important, and for this reason: The existing figures on unemployment do not and probably cannot be made to show merely the number of those who are both jobless and willing to work, at something or at anything. The figures, whether they report unemployment in terms of reduced employment or directly in terms of the number without jobs, actually do include persons of every degree of work-shyness, ranging from the person who is shy in respect to any kind of work to the person who is shy in respect to none. Thus, the figures upon which the Board is obliged mainly to rely—those from Massachusetts and New York—are not unemployment figures at all as the Board has marked out that term. They are idleness figures, and, indeed, that is the term used in the original state reports.

It does not seem to the reviewer that the Board has taken sufficient care in adapting to its own purposes the statistical source material which it uses. The reader certainly is left in the dark as to just how certain statistical conclusions are reached. On page 27 there are assembled in a table estimates (of the average

number of days lost per wage-earner) made in five different official investigations between 1885 and 1920. The highest average number of days lost is 63, the lowest 29; the other three investigations show figures falling between these extremes. The Conference Board, averaging the five estimates, foots up the table with 12 per cent as the "average idleness found per person employed," and 42 days as "the equivalent number of days lost per wage-earner per year." In its general summary at the end of the report the Board puts it at 42 days or 14 per cent of the "total working time" (page 86). One or the other, obviously, is incorrect. It is impossible to check up this discrepancy because the Board nowhere explains just how it deduces the number of days lost per wage-earner from the average percentage of idleness per wage-earner. In the same table the Board shows the "average idleness" reported by the United States Department of Commerce and Labor in its iron and steel investigation of 1910 to be "7 weeks or 13.5 per cent." The corresponding "equivalent days lost per wage-earner" are given in the table as 63, and referred to in the text as "about 63 working days of comparable length." The explanation, obviously, must lie in the very large amount of over-time worked in the iron and steel industry—over-time evidently equivalent, on the average, to more than two full weeks of over-time distributed over each 7-weeks period of straight time.

In its discussion of various causes and remedies the Board presents a balanced ration. Causes are listed as "internal" or "external," the internal causes being further subdivided into "personal" and "impersonal" factors, and external causes into those "of economic origin" and those "of political origin." Some official statistical evidence (from the same sources as indicated above, for the most part) is presented to show the proportion of unemployment, or idleness, rather, due to sickness, strikes, etc., and the proportion due to external causes of economic and political origin respectively. Figures are also given showing the proportions of separating employees who stopped voluntarily, were laid off, or were discharged. For the rest, the material consists of a somewhat brief and sketchy discussion of various causal factors. The discussion of remedies follows the same classification and, necessarily, is entirely descriptive. Some emphasis is placed upon personnel administration, improvement of employment facilities, reduction of transportation costs, encouragement of foreign trade, unemployment insurance, and public construction work. The report contains a number of interesting charts.

PAUL F. BRISSENDEN

Business Statistics: Their Compilation and Presentation, by R. W. Holland O.B.E. London: Sir Isaac Pitman & Sons, Ltd. 1921. 85 pp.

Although for the most part it maintains the point of view of actual business management, this book is meager. It defines business statistics primarily as statistics obtained from the financial and cost accounts of a business. There is little recognition of the wide range of non-accounting statistical data now being obtained from both internal and external sources for practical guidance in business management. Even within the field of business statistics that have their origin

in accounts, no recognition is given to the development of uniform accounting or to such statistics as those for stock-turn and credit ratios. The explanation of the advantages in basing expense percentages on sales instead of on cost is weak. The use of daily comparisons for practical administrative purposes in many businesses is unduly belittled. Over one half the book is given over to an elementary explanation of the preparation of charts. Despite several good features in the chapters on charts, the dangers of using a base-line other than zero are not adequately recognized, and in explaining the use of circular area charts it is stated that the areas of two circles are proportional to their radii! The book is hardly safe for beginners, and it will provide few new ideas for experienced statisticians.

MELVIN T. COPELAND

Report on the Food Supply of the Port of New York District. Report of the Port of New York Authority. Albany: J. B. Lyon Co. February, 1922. 74 pp.

This report fills a long-felt want of statisticians, economists, and public marketing officials, all of whom have on various occasions found themselves handicapped because they were unable to find in any one place the information contained in this pamphlet. The Port of New York Authority has collected in this report all available information regarding the annual and seasonal receipts of the most important commodities making up the food supply of the New York District.

For the purpose of ready reference a table on page 11 gives the calculated net receipts of those commodities which represent probably more than 90 per cent of the food consumed in the Port District annually. The extensiveness of this report may be indicated by listing the main groups of commodities for which general data as to receipts and sources of supplies are given in Section II. The groups are covered in the following order: milk and dairy products, flour and grains, meat and meat provisions, vegetables, fruits, fish, sugar, coffee, tea, dried fruits, dried beans and peas, nuts, vegetable oils and compounds, and lard.

A snapshot of the storage of foods within the Port District is presented in Section IV, which brings out the striking fact that the New York and New Jersey state authorities do not receive uniform reports on foods in cold storage. In fact, the statistics showing the New Jersey holdings were so meager that no total for cold storage holdings in the Port of New York District could be given. The New York State Department of Farms and Markets was able to give details on the various kinds of meats and poultry, whereas the New Jersey authorities merely classified meats and poultry broadly. The table on cold storage holdings clearly shows the need for a better coördination of records of supplies of foodstuffs on hand.

On looking into the holdings of food in dry storage warehouses, the Port Authority found that no agency, either public or private, kept records of these holdings. In fact, no public agency at the time this survey was started had even an up-to-date list of dry storage food-warehouses.

The statistician and the student of food-marketing problems will find it most profitable to devote their time and attention to a study of Appendix A, where they will find data on which the statements in Section II were based. Table I

in Appendix A (page 41) shows a somewhat different attitude in the analysis of the same commodities represented on page 11. In one place butter and cheese are grouped with milk under "Milk and Dairy Products;" in another, butter and cheese stand alone. In the table on page 11, live poultry and dressed poultry are placed under "Eggs and Poultry," and in Table I of the Appendix, live poultry and dressed poultry are placed under "Meats." Then, very strangely, after having made entirely new groupings in Table I, all of the remaining tables in the Appendix follow the order of the table on page 11.

The first table in the Appendix shows the "receipts," "deductions for outbound shipments, exports, and storage," and "calculated net receipts." Apart from being made to conform with the arrangements of the table in Section II, this table could have been improved had the exact amount of each deduction been shown in separate columns instead of having been lumped in one column. There should have been columns for exports, outbound domestic shipments, and net in or out of storage movements. Wherever possible, the domestic receipts should have been given separately from the foreign imports.

The tables in the remainder of Appendix A give the receipts of most commodities by months. Receipts of fruits, vegetables, butter, cheese and eggs are further classified by the states from which they are received.

Although the report mentions the names of the organizations from which the receipts of the various commodities were compiled, it is to be regretted that the footnotes to the tables as to sources are not more numerous. Some of the data in the Appendix were checked by the reviewer with statistics that he compiled independently for use by his classes in economics. In most cases it was found that the two sets of figures correspond closely. The reviewer, however, differs with the dressed poultry figures. Reference to the general statement of sources shows that whereas the live poultry figures were secured from the Urner-Barry Co., the dressed poultry figures were secured from the United States Bureau of Markets. A careful study of these receipts and a comparison of the Urner-Barry and the government figures over several years have convinced the reviewer that the Urner-Barry figures are the more accurate, and that the dressed poultry figures—stated at 101,292,133 pounds in this report—are about 25,000,000 pounds too small.

The food requirements for the Port District population were determined in another way in Appendix B and summarized in Section II. Here some six studies on food budgets were reduced to a common denominator and applied to the Port District population, which was taken to be 8,000,000 and reduced to 6,240,000 "equivalent adult males." In the determination of this latter figure, application of the Sydenstricker and King "fammain scale" (explained in the September, 1921, issue of this Journal) was made to New York City. A comparison of the selected estimate of the total annual consumption of certain foodstuffs with the calculated net foodstuffs shows close approximation.

In conclusion it may be stated that the report of the Port Authority is a distinct contribution to the literature on food distribution in the Port of New York. In addition to providing the first authoritative publication on the receipts of foods in New York, the report shows the need of a more effective method of

gathering and assembling current food information in a readily available form. The present study is in part accidental in that its original purpose was to form a basis for meeting the situation growing out of the threatened railroad strike last October. The collection of these data was the work of a committee of the various governmental agencies concerned with food distribution within the Port District, of which Herschel H. Jones was chairman. As the Port Authority is not likely to publish under normal conditions similar reports in the future, the trade and the public food-marketing bodies should work out a plan for joint future activities in this direction.

ARTHUR E. ALBRECHT

College of the City of New York

RECENT LITERATURE

STATISTICAL BOOKS

Angas, L. L. B. Reparations, trade and foreign exchange. London, P. S. King and Son, 1922. 351 pp.

Hansen, Alvin H. Cycles of prosperity and depression in the United States, Great Britain, and Germany, 1902-08. Madison, Wisconsin, University of Wisconsin, 1921. 112 pp.

Jones, D. Caradog. A first course in statistics. London, G. Bell and Sons, 1921. ix, 286 pp.

Jordan, David F. Business forecasting. New York, Prentice-Hall, Inc., 1921. xv, 270 pp.

Metropolitan Life Insurance Company. Lengthening life through insurance health work. A study of the trends of mortality among policy-holders in the Metropolitan Life Insurance Co., Industrial Department, and in the United States registration area, 1911 to 1920. New York, 1922. 11 pp.

Zizek, Franz. Grundriss der Statistik. München and Leipzig, Verlag von Duncker & Humbolt, 1921. vii, 470 pp.

UNITED STATES GOVERNMENT PUBLICATIONS

United States

United States. Bureau of the Census. Cotton production and distribution, season of 1920-21. Washington, 1921. 138 pp. (Bulletin 147.)

————Fourteenth Census of the United States. Population: 1920. United States. Composition and characteristics of the population. 42 pp. Bulletin.

Population: Porto Rico. Occupation statistics. 25 pp.

Agriculture: Summary of the census of agriculture for the United States, 1919 and 1920. 76 pp.

Bulletin. Agriculture: Texas. 94 pp.

Bulletins. Drainage: Arkansas, Nebraska, Texas

Forest products: 1919. Forest products consumed in the manufacture of veneers, dyestuffs and extracts and in tanning and wood distillation. 10 pp. Lumber, lath and shingles. 24 pp.

Bulletin. Irrigation: Texas

Manufactures: 1919. Florida, Iowa, Kansas, Louisiana, Rhode Island, South Carolina

Mines and quarries: 1919. Alabama, Florida, Georgia; Arkansas, Louisiana, Texas; California, Oregon, Washington; Colorado, New Mexico, Arizona; Idaho, Nevada, Utah; Kansas, Missouri, Oklahoma; Kentucky, Tennessee, West Virginia; Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut; Maryland, Virginia, North Carolina, South Carolina; Michigan, Wisconsin, Minnesota; Montana, North Dakota, South Dakota, Wyoming; Ohio, Indiana, Illinois, Iowa

————Mortality statistics: 1920. Washington, 1922. 112 pp. (Bulletin 148.)

——Children's Bureau. The practical value of scientific study of juvenile delinquents, by W. Healy. Washington, 1922. 31 pp.

——Bureau of Education. Bulletin, 1921. No. 30. Salaries of administrative officers and their assistants in school systems of cities of 25,000 inhabitants or more, by W. B. S. Deffenbaugh

——Federal Trade Commission. Report on milk and milk products, 1914–18. June 6, 1921. Washington, 1921. 234 pp.

—— ——Summary of report on the Pacific Coast petroleum industry. Part 2. Prices and competitive conditions. November 28, 1921. Washington, 1921. 21 pp.

——Commisioner of Internal Revenue. Statistics of income; compiled from the returns for 1919 under the direction of the Commissioner of Internal Revenue. Washington, 1922. 131 pp.

——Bureau of Labor Statistics. Bulletins

No. 284. Index numbers of wholesale prices in the United States and foreign countries. (Revision of Bulletin No. 173.) 350 pp.

No. 294. Wages and hours of labor in the slaughtering and meat-packing industry, 1921. 93 pp.

No. 295. Building operations in representative cities, 1920. 49 pp.

——War Department. The Medical Department of the United States Army in the World War. Volume XV. Statistics. Part One. Army anthropology; based on observations made on draft recruits, 1917-18, and on veterans at demobilization, 1919. Prepared under the direction of M. W. Ireland, by C. B. Davenport and A. G. Love. Washington, 1921. 635 pp.

——War Finance Corporation. Fourth annual report, for the year ended November 30, 1921. Washington, 1922. 42 pp.

ARTICLES IN PERIODICALS

Annals of the American Academy of Political and Social Science. January, 1922. The Federal Reserve system—its purpose and work

L'Economista. November 20, 1921–March 12, 1922

November 20. F. Flora: Un vecchio arnese. La situazione commerciale e finanziaria della Germania

November 27. Il protezionismo e i prezzi

December 11. F. Flora: Imposte dirette vecchie e nuove. G. Curato: L' Eposizione finanziaria

January 1. E. Giretti: A proposito di statistiche ufficiali

January 8–15. Prezzi delle merci e delle derrate alla fine di ciascun mese. Numeri indici dei prezzi delle merci e derrate

January 29. V. Pareto: Crisi bancaria industriale ed economica nazionale

February 5–12 L. Maroi: Importanza scientifica e sociale del censimento

Federal Reserve Bulletin. January–March, 1922

January. Federal Reserve banking during 1921. Interdistrict accommodation

February. Earnings and expenses of the Federal Reserve Banks. International price indexes: The British number. Recent international price fluctuations. Commercial credit practice of German banks. Foreign exchange operations, 1918–19

March. Member bank acceptances at the close of 1921. Tobacco finance. Indexes of trade and production. Commercial credit practice of Japanese banks

Giornale degli Economisti e Rivista di Statistica. November, 1921–February, 1922

November. F. Vinci: Nuovi contributi allo studio della distribuzione dei

redditi. E. Corbino: Il protezionismo marittimo in Italia. G. Madia: L' aumento dei salari dal 1914 al 1921

December. F. Vinci: Sull'estensione del teorema del Tchebycheff. A. Carnelutti: Il mercato e la crisi del salnitro. E. Corbino: Il protezionismo marittimo in Italia

January. G. Mortara: Il cotone. G. Majorana: Del diritto o del delitto di sciopere anche nei pubblici servizi. G. del Vecchio: Recenti contributi alla teoria dei prezzi

February. L. Amoroso: L'economia italiana nel 1921. C. Cozzi: Osservazioni intorno al regime attuale dei titoli privati. E. Corbino: Il protezionismo marittimo in Italia. T. Martone: Pagine staccate

Giornale di matematica Finanziaria. December, 1921. A. Barriol et I. Brochu: L'émission du Crédit National en 1921. F. Insolera: Sulla geometria delle operazioni di borsa. C. E. Bonferroni: Scadenza media e leggi di capitalizzazione

Journal de la société de Statistique de Paris. November–December, 1921

November. W. Oualid: L'évolution industrielle de l'Alsace–Lorraine et de la France de 1871 à 1914. R. Pupin: L'épargne française en 1920

December. E. Miche: La reconstitution des régions libérées et les dommages de guerre (au point de vue immovilier). Dugé de Bernonville: Chronique des questions ouvrières et des assurances sur la vie

Journal of Accountancy. February–April, 1922

February. W. B. Castenholz: Cost and production standards. H. M. Ingham: Accounting for contracts. N. B. Bergman: Accounting for pig iron production. J. B. Ballingall: Dairy accounting

March. J. Hugh Jackson: Choosing a profession—Accountancy. F. L. Wilkinson: Accounting for electric-light and power industries. W. W. Larkin: Cocoanut oil manufacturing. M. Bailey: Accounting for depletion of minerals

April. C. C. Roberts: Planning an audit of an industrial company
W. H. Bell: Depreciation and retirement of property. H. T. Scoville: Accounting as a profession. J. F. Mahoney: Commision problems simplified

Journal of Political Economy. February, 1922. Commission of the Association of Collegiate Schools of Business: Social studies in secondary education. D. A. McGibbon: The revolutionary cycle in syndicalism. H. G. Brown: The incidence of compulsory insurance of workmen. W. McAvoy: The economic importance of the commercial paper house. Z. C. Dickinson: The psychology course in business education. F. Richard-Robinson; F. A. Kingsbury and E. S. Robinson: A program for psychology in a College of Commerce and Administration. L. H. Seltzer and S. L. Horner: Bank reserves and the call money loan rate. W. H. Steiner: The classification of financial institutions. J. Bernhardt: Was the control of sugar in the United States advisable?

Journal of the Institute of Bankers. January–March, 1922

January. A. Williams: Bankers' advances on produce and the documents of title thereto. L. Le M. Minty: The loose leaf system of bookkeeping as applied to security work. J. Brunton: Irregular borrowings and the lender's remedies

February. A. Williams: Bankers' advances on produce and the documents of title thereto. Lectures 2 and 3. The work of the London Bankers' Clearing House during the year 1921

March. A. Williams: Bankers' advances on produce and the documents of title thereto. Lecture 4. L. Le M. Minty: The corporate trust department of an American bank. J. Brunton: Compositions and arrangements with creditors

Metropolitan Life Insurance Co. Statistical Bulletin. January–March, 1922.

January. 1921—The best health year. The health of working children.

February. Forty-six millions paid in death claims to Metropolitan beneficiaries during 1921. Lessons from recent typhoid fever statistics. More automobile fatalities than published figures show. Public health during last quarter of 1921

March. The recent influenza epidemic different from 1918 attack

Automobile fatalities continue to increase. Smallpox prevalence and case-fatality in the United States and Canada, 1919 to 1921

Diseases of the teeth and mouth as causes of organic disease. Death rates from alcoholism, 1912 to 1921. The accident hazard of working children

Monthly Labor Review. January–March, 1922

January. J. J. Davis: Disarmament in industry. R. M. Yerkes: What is personnel research? M. Dobbin: South America—labor unrest

March. E. Stewart: Trend of employment in the manufacturing industries in the United States, June, 1914, to December, 1921. Rajani Kanta Das: Rise of factory labor in India

Le Musée Social. October, 1921–February, 1922

October. Section agricole du Musée Social: Procès-verbaux des séances. Année 1918 et 1919

November–December. Same. Du 1er Janvier au 31 Mars 1921

January. G. Risler: La crise du logement

February. Dr. Williams: La Fondation Rockefeller pour la lutte contre la tuberculose en France. Son action pendant et depuis la guerre

Public Health. January–March, 1922

January. S. Barwise: Public health dentistry

Public Health Reports. Vol. 37. Nos. 1–13. January–March, 1922

No. 1. Mortality from cancer: 1920. Sickness frequency among industrial employees. Morbidity among a group of wage-earners, January, 1920 to June, 1921. No. 2. Diphtheria in the United States. Scarlet fever in the United States. Mortality from organic diseases of the heart, 1920. Mortality from tuberculosis, 1920. No. 5. Infant mortality in 1921. Infant mortality rates for certain cities in the birth registration area. No. 6. Deaths from influenza and pneumonia combined. Comparison of the first five weeks of the years 1919-22, inclusive, for certain large cities of the United States. C. E. A. Winslow and L. Greenburg: Note on the efficiency of various systems of air-conditioning in a munition factory. New U. S. life tables. No. 7. Cases of influenza reported by states. Influenza in cities of the United States, 1922. Typhoid fever in the United States: Case rates, January to November, 1921 and 1920, and medians for the years 1913 to 1920. Deaths from influenza in 96 great towns of England and Wales. A high death rate in Scotland. Death rates in a group of insured persons. No. 8. D. K. Brundage: Records of the small sick-benefit association as a source of statistics for the factory medical department. No. 9. J. Goldberger and W. F. Tanner: Amino-acid deficiency probably the primary etiological factor in pellagra. Death rate in every age group lower in 1920 than in 1919. No. 10. D. K.

Brundage: Sickness among office workers. A year's experience of a large manufacturing company which recorded the number of hours which each office employee lost from work on account of sickness and accidents. Influenza in Great Britain. No. 11. Deaths from lethargic encephalitis in the United States registration area, 1920. No. 12. C. Armstrong: Typhus fever on the San Juan Indian Reservation, 1920 and 1921. No. 13. Smallpox mortality in the registration area, 1916–20

Revue d'Economie Politique. November, 1921–February, 1922

November–December. Y.: La question des réparations depuis la paix. P. Pic: Une orientation nouvelle de notre législation économique. La participation aux bénéfices et à la gestion dans quelques lois récentes. C. Rist: Quelques définitions de l'épargne. Essai de critique. E. Villey: La problème monétaire. Déflation ou stabilisation

January–February. C. Gide: La coopération. La place qu'elle réclame dans l'enseignement économique. W. Wittich: L'introduction du franc en Alsace et en Lorraine. G. Paillard: La Convention du 9 décembre 1921 et le problème de l'Union latine vu de Suisse. L. Baudin: L'or du Transvaal

Revue des Sciences Politiques. July–December, 1921

July–September. F. H. Hankins: De quelques transformations politiques récentes aux États-Unis. C. Dupuis: Le droit international et la guerre mondiale. M. Lair: Les chefs de guerre allemands. I. H. Puget: Le Conseil d'Etat au temps de Napoléon. L. Pommery: La guerre économique en France envahie

October–December. E. Bourgeois: L'alliance de Bonaparte et de Paul Ier. P. de Rousiers: La marine marchande française pendant la guerre et depuis la guerre. E. Halévy: Comment Lord Palmerston passa grand homme. A. Rivaud: Un commentaire allemand du traité de Versailles. M. Lair: Les chefs de guerre allemands. J. Blociszewski: La politique japonaise en Mandchourie et le problème extrême-oriental d'après un publiciste anglais. B. Nikitine: Une petite nation, victime de la guerre: les Chaldéens

Rivista Internationale di Scienze sociali e Discipline Ausiliarie. December, 1921–January, 1922

December. Nuova teorie e nuove ipotesi in tema di demografia di guerra. C. Grilli: Il protezionismo dopo la guerra

January. G. B. Nicola: Motivi americani della conferenza di Washington. G. Gabrieli: Letteratura bancaria. R. Cerciello: Il controllo preventivo nella pubblica amministrazione

OTHER BOOKS

Alzona, Encarnación. Some French contemporary opinions of the Russian revolution of 1905. New York, Longmans, Green and Co., 1921. 117 pp. (Columbia University Studies in History, Economics and Public Law. No. 228.)

Bureau of American Ethnology. 36th annual report to the Secretary of the Smithsonian Institution, 1914–15. Washington, 1921. 604 pp.

Church, Arthur L. The training of a secretary. Philadelphia, J. B. Lippincott Co., 1922. 194 pp.

Journal of the Royal Society of Arts. Volume LXIX. From November 26, 1920 to November 11, 1921. London, G. Bell and Sons, 1921. 860 pp.

Raymond, Dora N. British policy and opinion during the Franco-Prussian war. New York, Longmans, Green and Co., 1921. 435 pp. (Columbia University Studies in History, Economics and Public Law. No. 227.)

NEW SERIES, NO. 139 (VOL. XVIII) SEPTEMBER, 1922

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Formerly the Quarterly Publication of the American Statistical Association

THE NET VOLUME OF SAVING IN THE UNITED STATES

MEASURED BY THE INCREASE IN THE TOTAL WEALTH OF THE COUNTRY [1]

By Willford I. King, *National Bureau of Economic Research*

Part I

A. INTRODUCTION

From time to time, various economists and financial writers have presented estimates of the extent of saving in the United States. In most of these cases the term "saving" has not been carefully defined. If the word had only one commonly accepted meaning, this omission might be a matter of but slight moment; but, as a matter of fact, the term is used in a number of different senses which are but slightly related to one another. In most instances, however, the statement of the purposes of the investigation enables a reader who is himself familiar with the various usages of the word to select the particular definition of saving which is applicable. A perusal of their writings will show that some investigators have sought to ascertain the relative thriftiness of different classes of the population. Others have been interested in the actual or potential supply of loanable funds. Some have sought to ascertain the adequacy of the provisions made to meet periods of adversity. Still others have desired to measure the increase in the wealth of the nation.

It is to be feared that some writers on the subject have not only failed to define the term "saving" in a formal way but have sometimes included in their aggregate of "savings" items that do not logically belong in the category under discussion. In order to avoid falling into a similar pitfall it seems highly desirable, in undertaking a new study,

[1] Acknowledgment is hereby made to the National Bureau of Economic Research for its grant of all the facilities necessary for the making of this study.

to discuss the various types of saving and to set rather precise limits to the field which is to be covered. Such a procedure is attempted in the pages which immediately follow.

B. THE MEANING OF THE TERM "NET SAVINGS"

Accumulation Versus Retention of Assets.—Saving may be thought of either as the accumulation or the retention of assets. Thus we say that by careful economy a man has saved a competence from his earnings, meaning of course that he has accumulated wealth little by little; but we also say that one man has saved his inheritance while another has squandered what was left to him by his parents. In this latter usage there is evidently involved no thought of accumulation but only the idea of successful retention of assets. This use of the term "saving" as synonymous with the retention of wealth has been emphasized by many economists in connection with the effect of waiting and abstinence upon the interest rate. When, however, one speaks of the volume of saving in a country, the reference is invariably to the accumulation and not to the retention of assets, and it is the rate of this accumulation which statisticians frequently attempt to measure. The discussion which follows will deal exclusively with saving defined as a process of accumulation.

Does Saving Connote Effort or Sacrifice?—Popular usage often associates the term "saving" with effort and sacrifice. Thus it is felt that the workman who toils arduously and uses only a small fraction of his earnings for the purchase of consumption goods is necessarily a great saver. If, however, he invests these earnings in "wild cat" securities or loses them at the gambling table, he is nothing ahead at the close of the year. If his procedure constitutes saving, it is certainly not of the type that can be dealt with successfully by the accountant or the statistician; they find it most practical to define net saving as an increase in net assets[1] between any two given dates.

Net Saving Defined.—From this point of view, *net savings are additions to the stock of consumption goods or increases in the power to produce or acquire income which have arisen through the acquisition of property or through investments in education.*[2] This definition is the one which accords with the purposes of this investigation.

Saving May Be Fortuitous.—According to this definition, saving may involve no effort on the part of the saver, for net assets often increase through purely fortuitous circumstances. Since, however, such gains might readily be used for the purchase of consumption goods,

[1] "Net assets" in accounting parlance means the total value of property owned less total indebtedness.
[2] It is impracticable to measure statistically gains in the form of investments in education.

there seems no reason for excluding from the category of savings such gains as may be retained to the end of the period under consideration.

The Nature of the Objects Saved.—Any complete analysis of saving must deal not only with the process but also with the nature of the objects saved. Saving presumably began with the accumulation of stores of consumption goods. Early in the history of the human race, however, saving began to take the form of improvement in the equipment used in getting a living. Today we convert our efforts into railways, buildings, machines, tools, and other devices which enable us to utilize more easily the resources and forces furnished us by nature. Some of the most expensive and important forms of saving are not tangible but consist of such things as accumulated scientific knowledge and the training of the human mind. Savings of the last-mentioned variety are extremely perishable, since they are constantly being lost through the death of the persons possessing the education. Accumulated scientific knowledge is, on the other hand, the most durable form of savings. Although it is true that new discoveries and the introduction of new processes do frequently diminish or nullify the value of certain kinds of knowledge, it nevertheless seems highly probable that the proportionate loss in this field is far less than that which occurs in the case of buildings, machines, and the like.

C. AN ANALYSIS OF THE PROBLEM OF MEASURING THE SAVINGS OF THE NATION

The Savings of the People of the Nation.—Saving may be considered not only in connection with the nature of the objects saved but also as regards the persons or groups who save or who are the beneficiaries of the saving. Thus, we may, for instance, study saving from the national point of view. A nation's savings during any period evidently are comprised of increases in:

(1) The stock of wealth in the form of material goods used either for production or for consumption by the government or by the inhabitants. This evidently includes improvements in the land itself as well as additions to the stock of buildings and of movable goods.

(2) Valuable claims[1] against other nations or their inhabitants.

(3) The accumulated store of scientific knowledge.

(4) The productive power of the individual inhabitants resulting from education, hygienic measures, etc.

[1] These claims are evidences of equities in a stock of tangible goods located abroad which either have been produced or are expected to be produced.

The Effect on National Saving of the Diminution in Free Goods and in Natural Resources.—The fact should not be overlooked that the net increase in the stock of material wealth (free goods plus economic goods) is likely to be distinctly less in amount than the increase in the stock of economic goods; for while the quantity of machines, buildings, and similar improvements has been rapidly increasing in most civilized countries, there has been at the same time a decided diminution in the aggregate of the undeveloped resources of the nation. In the United States, for example, there no longer exist the once great areas of fertile land awaiting the plow or the vast forests of virgin timber which formerly covered much of the country, and our mineral resources likewise have been largely exploited.

It is necessary to remember also that in the realm of economic goods the loss of soil fertility and the depletion of our mines goes far to offset the increase taking place in the quantities of goods produced by the aid of man's efforts. Allowance for such deterioration is always necessary before any accurate picture of national saving can be obtained.

It is, however, doubtless true that the loss in natural resources has been offset to no inconsiderable degree by the bringing into use of new land which, under the conditions prevailing at an earlier period, had little or no utility to mankind. Furthermore, science has given great utility to national resources which were formerly wholly useless. That this factor is not of negligible importance is made evident when we remember that two centuries ago anthracite coal was believed to be fit only for ballast, that no means had been invented for utilizing more than an infinitesimal fraction of the available water power, and that rubber was deemed useful merely for pencil erasers. These are only a few of the many similar examples which might be cited.

Although the changes which have occurred in the inventory of natural resources are very real they are also extremely difficult to measure with any reasonable degree of accuracy, and the problem of calculating the national savings is greatly complicated by this fact.

Saving by Governments.—National saving differs radically from governmental saving. The latter is usually referred to as public saving. Governments accumulate:

(1) Public buildings, parks, canals, roads, vessels, machinery, etc.
(2) Money or credits—in other words, valuable claims against private persons or other governments.
(3) Improvements in the administrative system and organization.

Private Saving.—Private saving is much more akin to governmental than to national saving. Private saving is carried on both by individ-

uals and by business units. At the present time the larger business units are principally organized in the corporate form, while the smaller businesses are conducted mainly by individuals. In the latter case it is often impossible to distinguish the savings of the business from the personal savings of its owner. Private savings consist of:

(1) Increases in stocks of consumers' goods (direct goods).
(2) Improvements in business equipment.
(3) Improvements in business organization.
(4) Increases in holdings of money and credits—that is, in holdings of valuable claims against governments or other business enterprises or persons.
(5) Acquisitions of stock or part ownership in other business enterprises.
(6) Improvements in acquisitive power due to educational or hygienic measures.

Money and credits (the fourth in the list of private savings) are often given especial prominence by writers on the subject of saving because this form of savings is commonly used for one of two purposes, both of which are of great importance in their effect upon business activity. Money and credits are commonly either exchanged for other goods (thus affecting market prices), or are loaned to entrepreneurs in order that they in turn may either obtain commodities needed in their business or gain control of other enterprises (thus affecting interest rates).

Savings Affected by Changes in the Price Level.—In the computation of savings in terms of money value, it is of course imperative to eliminate at the start all changes in values resulting from variations in the price level. The price indexes obtainable may themselves be so erroneous that this single necessary correction will in itself be sufficient to prevent estimates of most classes of savings from attaining any high degree of accuracy. This, however, is only one of several obstacles tending to hinder the statistician who undertakes inquiries in this field.

The Volume of Private Saving is Not Necessarily Gaged by the Value of New Securities Floated.—The assumption is frequently made that the extent of saving in a country can be measured by the volume of funds offered for investment in notes, bonds, mortgages, or similar securities. It is true that a large part of such loanable funds consists of amounts set aside from current income for investment purposes. However, it is also true that when business men are optimistic concerning the business outlook they desire to invest most of their free funds in

entrepreneurial undertakings, but when they become pessimistic they curtail the extent of their operations and become desirous of loaning not only part of their current income but also money accumulated through reduction of inventories.

It is true, however, as is shown in Part II of this article, that in years when business profits are large the sales of bonds likewise are generally above normal. This increase in bond sales presumably represents principally a rise in the curve representing the demand for loans rather than an increase in the supply of loanable funds offered at a given interest rate, for it is a well-known fact that in boom times interest rates rise sharply. It appears, therefore, that the supply of loanable funds offered at any given interest rate may be a poor criterion of the extent of private saving in the country. This lack of direct relationship, however, does not preclude the fact that variations in the actual sales of bonds may be a rather good gage of changes in the volume of private saving in general. But, even though bond sales measure roughly fluctuations in the volume of private saving, it is evident that since private savings may represent no accessions to the national wealth, bond sales are not necessarily good criteria of the accumulations made by the nation as a whole.

Some Types of Saving Not Measurable.—It is extremely difficult if not entirely impracticable to measure statistically savings embodied in human beings. The statistical part of this study will therefore be confined wholly to those savings external to the people themselves. But, owing to the paucity of available data, it is far from possible to measure all the types of external saving concerning which there may be a widespread interest. Although it is, for example, as stated above, perfectly feasible to ascertain the approximate amounts invested each year in certain types of securities, it seems entirely impracticable to estimate another related quantity, namely, the potential supply of loanable funds. In attempting the computation of this quantity, certain students seem to have made the assumption that the aggregate volume of private saving in the nation is a more or less immutable quantity which cannot be changed materially but which can only be shifted from one field to another. There seems to be little ground for accepting the validity of this hypothesis. As a matter of fact, the extent of private saving seems to vary greatly with different phases of the business cycle, and it appears highly probable that in time of great national emergency the people of the United States might save treble the average amount laid aside in normal times. In fact, the only limit upon possible saving is that enough of the net personal income remain for consumption to supply the population with the barest necessities,

and this minimum would doubtless require considerably less than half the total income of a prosperous nation like the United States. The measurement of the potential supply of loanable funds evidently involves the determination of a supply curve at each date; for manifestly the supply offered would vary according to the rate of interest. Since there is every reason to believe that there are wide variations in the conditions affecting both the demand for and the supply of loanable funds, it appears to be extremely difficult if not impossible to derive for this field either supply or demand curves which can lay any claim to even approximate accuracy.

Net Private Saving Very Different from Gross Private Saving.—In dealing with the question of savings, it is well to remember that one can gain no adequate idea of the volume of national saving by adding together gross private savings of various kinds, the reason being that these gross private savings are so largely offset by losses, wastes, and expenditures for consumption goods, and that the net amounts remaining are often relatively trivial. For example, very many millions of dollars of savings are invested each year in enterprises which fail, and these savings are thereby dissipated. Billions were saved by the American people and invested in Liberty Bonds, but the proceeds were used to purchase war supplies, and hence the country is now little if any richer because of the saving. The savings of the working classes are largely utilized to cover the expenses of vacation outings, weddings, and funerals. Such uses evidently lead to no increase in the nation's wealth. It follows that the volume of gross private saving does not necessarily bear any fixed ratio to the volume of net private saving remaining after all deductions have been made; hence the former cannot be regarded as an accurate criterion by which to measure the latter.

If, however, it were possible to ascertain for any given interval of time the net savings of the various individuals in the country, and if these net amounts were summated and their aggregate added to the net savings of all governmental units during the same period, the total would represent the quantity most sought in this study, namely, the net national saving for the period.

Measurable Types of Saving.—Owing to the numerous difficulties involved in the statistical measurement of savings it is the part of wisdom for the statistician to confine his efforts to measuring those few types of saving for which fairly satisfactory data are available. Even in these few cases the margin of error is likely to be large. However, it is probably true that mere approximations may prove to be of considerable value. In some instances in which absolute measurements are impracticable, it is still perfectly possible to obtain figures which

show the relative fluctuations in the volume of accumulation, and these figures throw light on certain economic problems.

The following outline shows the relationship to each other of some of the numerous types of saving in the United States. These types have been selected because they seem to be both susceptible of rough statistical measurement and also of sufficient general interest to warrant an effort to compute their volume.

I. First, classification of the annual increase in the entire wealth of the nation.
   A. The increase in the net value of claims against foreign nations.
      1. Private claims.
      2. Claims of the United States Government.
   B. The annual increase in the internal wealth of the United States.
II. Second classification of the annual increase in the entire wealth of the nation.
   A. The increase in the value of claims of the federal government against foreign nations.
   B. The increase in the value of the other assets of governmental units. (These assets can be estimated only in a very rough way.)
   C. The volume of business savings. (This estimate must be based mainly upon the reports of savings by corporations.)
   D. The net amounts saved by the people from their personal incomes. (This quantity can be calculated only roughly by subtracting estimated business savings from the estimates of total private savings.)

It is therefore to the measurement of these selected items that the statistical studies which follow are directed.

The Use of Money Values in the Measurement of Savings is Unavoidable.—In the calculation of the amount of saving we are primarily interested in the increase in the utility of the stock of goods on hand and not in the increase in their money value. The direct measurement of the total utility of the nation's stock of goods is, however, practically impossible. We are driven, therefore, to the indirect method of using money value as an intermediary through which we must pass in order to arrive at a measure intended to indicate for different years the relative income commanding power of the stock of wealth on hand. As a first step in this direction it appears necessary to estimate the current valuations placed each year upon the internal wealth of the nation.

If values are to be used in a measurement of wealth which in turn is to be taken as a basis for computing savings, the question arises as to whether we shall base our estimates upon the values of property rights represented, for example, by stocks, bonds, and paper money, or whether we shall confine ourselves to a study of the values of physical wealth only. The former method is more direct and is at least as accurate in principle as the latter. The practical reason for confining our studies to valuations of physical wealth is that while the census reports profess to cover this form completely they furnish us but little

information concerning the value of property rights. Since the census gives us our only broad base, we have, then, little choice as to the procedure to be followed. As a matter of fact, it seems reasonable to suppose that the net value of all property rights is approximately equal to the net value of the physical wealth upon which those property rights are based.

We must not lose sight of the fact, however, that when wealth is expressed in terms of value, the value is a measure of property rights and not of a quantity of physical objects or of an amount of utility.

In Measuring Savings all Property Values must be Treated Alike.—Since we have defined national saving as being equivalent to the sum of private and governmental saving, and since either of these kinds of saving is measured by the increase in net worth between two dates, there is evidently no distinction whatever to be made between the values of different types of property. It is, therefore, wholly immaterial whether the property value is based upon land or other national resources, upon buildings or equipment, or upon consumption goods. In any case, if the price level has not changed, every gain in net worth is to be counted as saving.

The General Plan of Attacking the Problem.—In order to measure the total savings of the people of the nation, the most feasible procedure seems to be to take the following successive steps:

1. Measure the total wealth as expressed in dollars of the current year.
2. Find what the wealth in each year would have been worth if the price level had remained the same as in 1913.
3. Ascertain the increase during the entire period in this wealth measured in unchanging dollars.
4. Apportion this increase as accurately as possible between the different years of the period.

In order to understand the nature of changes in wealth it seems necessary first to analyze rather carefully the principles which determine the valuation of indirect goods.

D. THE PRINCIPLES OF VALUATION AND THEIR RELATIONSHIP TO THE VALUE OF WEALTH AS REPORTED BY THE CENSUS BUREAU

How Indirect Goods Are Valued.—A large part of the economic wealth of the people of the United States consists of real estate, transportation systems, and machinery—all typical examples of durable indirect or production goods. Such goods derive their value wholly from the anticipated values of the future services which they are ex-

pected to render or of the products to which it is anticipated they will give rise. Each owner or prospective purchaser who is interested in these goods from the standpoint of income discounts the values of these various future products or services at his own subjective interest rate and adds the resulting amounts together to arrive at a total which represents the present subjective value of the goods in question to the given individual. A dealer or speculator, however, may have no direct interest in the services which the goods are expected to render, for, if an owner, he hopes to sell the goods soon; if a prospective purchaser, he intends to buy merely in the hope of making an early sale at a quick profit. His subjective price, therefore, represents not discounted income payments but merely his anticipated selling price discounted to the present date at his subjective interest rate. In times of active speculation both buyers and sellers sometimes almost entirely lose sight of the income expected from the goods; but such a condition of affairs is usually quite transitory. Prices based upon the present worth of anticipated services are the forces which in the long run are dominant.

The subjective prices of all interested persons whether speculators, dealers, or investors, impinge upon each other in the market, and in this way a price is determined at which exchanges of some units actually occur. This market price is then commonly imputed by the statistician to all units existing under like conditions. Statisticians add together the estimated values thus arrived at to obtain estimates of the total value of a given kind of wealth.

Value of National Wealth Fluctuates with Every Change in Public Opinion.—The above analysis indicates that the value of wealth in a country at any given date is fundamentally dependent upon the subjective valuations placed upon the various items by persons owning or dealing therein. Anything that changes these subjective valuations must then necessarily affect the total value of the wealth of the country. Each person in fixing his subjective value for any article is influenced primarily by two factors: first, his belief as to the value of the service or product at the date at which he expects it to be disposed of; second, his present subjective rate of discount for future values.

It follows, therefore, that whenever most of the interested parties change their opinions as to the future selling price of the products, the present value of indirect goods at once changes. This is easily illustrated by the value of a share of stock. If it is the current opinion that the stock in the future is likely to earn on the average 5 per cent per annum, the stock may sell for $40 per share; but if for any reason

whatever—perhaps only because of an entirely baseless rumor—most of the persons owning or desiring to purchase the stock are suddenly convinced that it will probably earn, for an indefinite period, an average of 10 per cent, the value of the stock will quickly increase to the neighborhood of $80 per share. Similarly a change in opinion as to the prospective level of railway rates will affect the value of railway systems, and an increase in optimism on the part of steel manufacturers will enhance the value of steel works.

A change in opinion concerning interest rates is no less important in affecting subjective and market values than is a change in beliefs concerning prospective selling values. When a man who has been estimating that money is worth 4 per cent to him suddenly decides that it is instead worth 6 per cent, the present worth to him of every item of future income, and hence of durable goods in general, evidently drops off sharply. If others generally change their views in the same way, the resulting fall in subjective values tends quickly to lower market values.

From what has just been said, it follows that the value of the economic wealth of the country really fluctuates up and down, not in proportion to changes in the average prices of consumption goods, but rather in consonance with waves of feeling regarding interest rates or pertaining to anticipated future prices.

Statistics of Wealth Values Commonly Represent Trends rather than Current Values.—Such oscillations, however, are likely to be smoothed out to a considerable extent in statistical reports of aggregate wealth, for these reports are often based upon inventory valuations as carried upon the books of business concerns, and these "book values" are commonly more closely connected with costs or with records of financial transactions than with actual present values. This point must be kept in mind in dealing with statistics of wealth as commonly presented. The United States Census of Wealth should, for this reason, be regarded as recording rather an approximation to the trend of total values than the actual sum of the market values at a given date.

Saving is Better Measured by the Trend than by a Record of Actual Values.—In measuring the savings accruing during a given period, it evidently is necessary to adjust the inventories at the beginning and at the end of the period to allow for changes in the purchasing power of money. It appears also from the preceding line of reasoning that, if possible, adjustments should be made to counteract variations in values due to shifts in the public psychology in the direction of optimism or pessimism; for it seems rather absurd to say that the nation

has suddenly saved fifty billions of dollars because the interest rate has fallen or because a wave of optimism has just swept over the country. Yet such causes might easily produce such a change of values in the course of a few months. In practice, however, it is most difficult to make corrections to offset price level changes. Presumably, one of the best methods of eliminating those changes in the value of property arising merely from transitory changes in public opinion is to read the desired values at the various required dates rather from a smooth trend than from the actual values prevailing at the various dates. Since, in practice, the data are commonly too inaccurate to permit of more than a rough approximation to the truth, it is unnecessary to devote much energy to refining the methods of treatment. It is nevertheless desirable that the ideal sought should be visualized as clearly as possible.

The Census Bureau's Estimate of the Value of the Wealth of the United States.—Having considered the principles determining the valuation of durable goods, let us now see how these principles affect estimates of wealth such as have been made from time to time by the United States Census Bureau. A large part of the wealth of the United States consists of lands, buildings, factories, furniture, automobiles, clothing, and other articles which change hands only occasionally. This condition is especially characteristic of publicly owned real estate, such as canals, parks, and public buildings. Rarely, indeed, are land, buildings, and factories standardized commodities. An article included in any of the types mentioned above may either have deteriorated greatly or may have been greatly improved since the date of its last transfer. The price level may also have shifted much during the interval. Interest rates may have changed greatly. Under these circumstances, it is altogether probable that subjective values will, as a rule, have either risen or fallen materially, and, if so, the price at which the goods would sell if placed on the present market might differ radically from that paid for it when it was last sold. The present owner can, at best, measure accurately only the change in his own subjective value and can merely guess at the price which the article would bring if placed on the market; and yet his guess is likely to be better than that of most other persons. An actual enumeration of the valuations representing the unbiased opinions of the owners of property would be subject to some error, though it might be that the principle of compensation would so operate as to make the error of the total small.

The Census authorities have, however, not thus far attempted any such enumeration. In the case of the most important class of property,

real estate, they have depended mainly upon valuations placed thereupon by tax assessors, and these of course are likely to vary widely from the truth. Since, in most localities, assessed values are lower than market values, it has been incumbent upon the Census authorities to multiply the total assessed value in each locality by a factor which it is supposed will give the true market value as a product. The ascertainment of the correct multiplying factor is obviously no simple task. When we consider the weaknesses of this method, it is no reflection upon the efficiency of the Census Bureau to say that its valuations of the real estate of the country represent only approximations to the facts. Yet there seems reason to believe that the Census Bureau's valuations of real estate are more accurate than are those made for some other classes of property. It appears, therefore, that the census totals must be regarded merely as rough approximations to the value of the physical wealth of the country. Nevertheless, since they are the only figures available, it is necessary to use these estimates as the basing points for any study of wealth in the United States.

E. AN ESTIMATE OF THE CURRENT VALUATIONS PLACED UPON THE WEALTH OF THE UNITED STATES FOR THE YEARS 1909 TO 1919

The last estimate by the Census Bureau of the wealth of the country was made for the early part of 1912. For our purposes it is desirable to obtain a figure representing the value of the physical wealth of the country at the beginning of each year since 1909. The method followed in estimating the valuations placed each year upon the total internal wealth of the nation has been to assume the 1912 census figures for each category to be correct and to vary the figures for each kind of wealth in the other years since 1909 in proportion to the changes in an index number believed to represent the variations in the current value of that particular type of property. One advantage of this method is that the errors in the estimates of the different types of wealth are likely to compensate each other to some extent, thus reducing the error of the aggregate of all kinds of wealth. Fortunately, also, the nature of the available data makes this method of attack more feasible and convenient than any other. This mode of procedure necessitates the computation for each of the census categories of a corresponding appropriate index, the fluctuations of which are then assumed to be proportional to these categories in the value of that form of wealth. The manner of deriving the indexes for the respective fields is briefly indicated in the paragraphs that follow.

Real Estate.—Real estate has, for purposes of this study, been

divided into three categories, namely, urban real estate, farm lands, and farm buildings. The method used in estimating the value of farm lands involves the assumption that farm acreage increased at a constant rate between 1910 and 1920. The total value for each year is computed by multiplying the acreage calculated according to this premise by the average land value in that year. This average land value has been estimated by combining the reports of the Census and the estimates of the Department of Agriculture, as recorded in the *Monthly Crop Reporter*.

The assumption followed in calculating the value of farm buildings is that these buildings have increased steadily in physical quantity and that the value of each building has varied from year to year in proportion to the rent index prepared by the United States Bureau of Labor Statistics. By use of a composite index based upon these two assumptions, values have been interpolated for the intercensal years—that is, between the 1910 and the 1920 census estimates.

The total value of agricultural real estate in 1912 has been estimated in the manner just described, and this total has been subtracted from the total value of real estate as reported by the Census Bureau. Although the remainder represents mainly urban real estate, an appreciable fraction thereof consists of mining[1] and other property situated in rural regions. However, these amounts are scarcely large enough to vitiate seriously the results obtained by using as an index the value of urban real estate as shown by the city tax departments for the various years of the decade.

The reports of the Census Bureau entitled *Financial Statistics of Cities* purport to show the assessed value of real estate and the ratio of the assessed value to the true value in each city of considerable size for more than half of the years of the decade. The supposed true value of the real estate in each city has been computed therefrom by division. The usefulness of these figures as criteria of realty values is distinctly lessened by the fact that apparently little care has been taken by the Census authorities to enter the assessment reports under the year to which they actually apply. Fortunately, direct city reports are available for the larger cities (which virtually dominate the totals), and data from these have been largely substituted for the amounts appearing in the *Financial Statistics of Cities* as basic materials for our index. In the case of the smaller cities it has been necessary to utilize the census figures as they stand. Any error arising from this source is not likely to be important for the reason that the course of the total

[1] Walter R. Ingalls, in Chapter IV of his *Wealth and Income of the American People*, estimates the value of the mines in 1916 as $3,880,000,000. This would represent about 5 per cent of all non-agricultural real estate.

of city realty values has been steadily upward throughout the period, and, with a slope so nearly constant, a slight shifting of the curve from left to right is not a matter of great moment, as it will have a negligible effect on the final results. The estimated value of urban real estate in 1912, multiplied by the indexes for the various years, gives the estimated total value of urban realty for each year of the decade.

Live Stock and Farm Implements and Machinery.—The 1912 census valuations for the above named types of farm property have been assumed to vary respectively in proportion to the estimates of the values of the same items made by the National Bureau of Economic Research in connection with its studies of agricultural income in the United States.

Gold and Silver Coin and Bullion.—The value of the stock of precious metals recorded by the Census Bureau for 1912 has been assumed to vary in proportion to the estimates of the stock of gold and silver money in the United States as shown in the reports of the Comptroller of the Currency.

Manufacturing Machinery, Tools, etc.—No adequate criterion of the changes in the amount of this category of wealth seems to be available. Under the circumstances it has been assumed to vary in proportion to the reported capital of manufacturing concerns. The possible error of this method is further increased by the fact that estimates for capital are available only for the census years 1909, 1914, and 1919, and therefore amounts for intervening years must be obtained by interpolation. In this case a smoothed curve has been used as the medium for accomplishing this end. The quantities arrived at, therefore, although probably far from accurate, may nevertheless serve to indicate the general trend in the amount of this type of wealth.

Railroads and Their Equipment.—The first impulse would lead one to turn to the physical valuation of railways by the Interstate Commerce Commission as a guide to their total value. A little reflection, however, shows that this physical valuation is intended only to measure some form of cost, and may show nothing about present value which depends entirely upon estimates of future earning power. It may well happen that owing to rate regulation, for example, the market value of the railways may have declined although both the investment in railway enterprises and the physical quantity of every kind of railway property may have increased during the same period. Such a contingency leads one to inquire whether the use of the total market value of railway securities may not give rise to serious errors in the aggregate estimate of wealth. A little consideration, however, leads one to see that the specified state of affairs furnishes no ground for

suspicion; for while the reduction of railway rates forces down the value of railway property, it enhances to an equal extent the value of the property of the shippers. The correctness of the total of all wealth is then in no way vitiated.

The most logical measure of the value of the railways of the United States seems, then, to be the total value of their outstanding securities. Fortunately, the Interstate Commerce Commission reports for each year the par value of railway bonds outstanding and also the face value of stocks paying dividends and of those not paying dividends. The value of the latter class has been assumed to be one fourth as much per share as the value of the first class, and the two classes of stocks have been combined on this basis. The total for each year has been multiplied by the index of railway stock prices published by the Harvard Committee on Economic Research. Similarly the total face value of railway bonds outstanding for each year has been divided by the average yield on such bonds [1] to attain an index of bond values. The stock and bond indexes have, after appropriate weighting, been combined, and the combined index has been used as a criterion by which to measure changes in the total value of the railways of the United States in each year. While this index is doubtless not highly exact, it does not seem probable that it is seriously erroneous in any year.

Public Service Enterprises.—The ideal method of measuring the variations in the value of such concerns would be to follow the procedure just outlined in the case of railways. However, no summary of the capital and bond issues of such enterprises has been discovered. Under the circumstances, the very doubtful assumption has been made that the values of these properties have varied in proportion to the respective total income returns for the preceding years on all property invested in this field. The relative stability of corporate income in this field prevents the conclusions reached from being as erroneous as would be the case in most other lines of industry were this method applied thereto.

Agricultural Products.—It has been assumed that the value of agricultural products on hand January first has varied in proportion to the total value of such commodities produced in the preceding year. The validity of this assumption is of course lessened by the fact that the amount of crops and live stock held over and the rapidity of export vary from year to year. On the whole, however, it appears that this criterion is sufficiently accurate for most purposes.

Manufactured Products.—The stock of manufactured goods on hand at the first of the year has likewise been assumed to vary in pro-

[1] Also reported by the Harvard Committee on Economic Research.

portion to the gross output of the factories during the preceding year. Presumably the net output for the last half of the year would be the ideal criterion, but figures therefor are not available.

Imported Merchandise.—It seems that the value of the stock of imported merchandise on hand January first ought to be about proportional to the volume of imports for the fiscal year ending the succeeding June thirtieth. The estimates here stated have been computed according to that premise.

Mining Products.—The total value of mineral production for the preceding year, as recorded by the United States Geological Survey, is apparently the best available gage of the probable stock of mining products on hand at the first of the next calendar year. The estimates here presented have been made according to this assumption.

Automobiles.—In the study of the automobile repair industry,[1] an estimate was made of the total cost of replacing with new cars of the same type all cars in use at the first of each year. Of course they are, as a rule, not new but partly worn out. It has been assumed that their present value is 60 per cent of their value were they new. This item has therefore been added directly to the estimate of the value of the other kinds of wealth in the nation.

Clothing, Personal Ornaments, Furniture, Carriages, etc.—Since no satisfactory variable representing this group has been discovered, the assumption has been made that the value of the entire stock of consumption goods other than automobiles varies in proportion to the total value of all other physical wealth in the country.

The Current Valuation Placed on all Physical Wealth in the Nation.—The aggregate of the current valuations of the physical wealth in the United States has been computed by the simple process of adding together for each year the items above listed. To the quantity thus obtained, it is evidently necessary to add the net amount of American holdings and credits abroad in order to arrive at the total value placed upon the property of the United States and its people.

Net Holdings in and Claims against Foreign Countries.—In view of the relatively slight importance of this item, the very rough nature of the estimates of the values placed upon other types of wealth, and the existence of a very good study along this line made by Professor John H. Williams and Mr. Frank Vanderlip, it has not seemed worth while to make an independent investigation of the extent to which this country and its citizens are indebted to or have claims against foreign people or nations. The study just referred to is published in the *Harvard Review of Economic Statistics*. While the data are not presented

[1] Made in connection with the estimate of income in the United States.

TABLE I

THE ESTIMATED[1] VALUE AT THE BEGINNING OF THE YEAR OF THE INTERNAL WEALTH AND FOREIGN HOLDINGS OF THE GOVERNMENT AND PEOPLE OF THE UNITED STATES, MEASURED IN PRICES CURRENT IN THE SPECIFIED YEARS

(Millions of Dollars)

Beginning of year	Urban realty and mines	Farm realty	Live stock	Farm implements and machinery	Agricultural products	Gold and silver coin and bullion	Railroads and their equipments	Public service plants and equipments	Mining products
1909	$64,432	$33,849	$5,724	$1,021	$5,091	$2,441	$14,637	$8,777	$675
1910	66,096	34,801	6,203	1,111	5,483	2,455	15,564	9,331	799
1911	73,274	35,289	6,582	1,148	5,722	2,514	15,791	10,599	843
1912[2]	74,644	36,032	6,238	1,368	5,240	2,617	16,149	10,265	816
1913	77,010	38,092	6,767	1,446	5,540	2,686	16,144	11,164	950
1914	80,011	39,095	7,137	1,343	5,957	2,730	15,390	11,319	1,034
1915	81,845	40,530	7,157	1,457	5,758	2,795	14,585	10,978	897
1916	82,726	44,823	7,158	1,637	6,487	3,090	15,682	12,524	1,014
1917	84,447	48,347	7,890	2,081	8,121	3,634	15,921	14,524	1,485
1918	86,649	52,950	9,503	2,680	10,982	3,946	12,883	14,069	2,114
1919	87,801	59,900	9,986	2,907	13,242	3,838	12,830	11,767	2,346

Beginning of year	Manufacturing machinery, tools, etc.	Manufactured products	Imported merchandise	Automobiles	Clothing, personal ornaments, furniture, etc.	Total internal physical wealth	Property rights in foreign countries	Total current valuation of wealth
1909	$5,037	$11,107	$623	$301	$10,552	$164,241	$−1,637	$162,604
1910	5,366	14,261	754	431	11,167	173,822	−1,697	172,125
1911	5,727	15,018	757	587	11,931	185,701	−1,757	183,944
1912[2]	6,091	14,694	827	697	12,062	187,739	−1,817	185,922
1913	6,377	16,591	906	731	12,662	197,077	−1,877	195,200
1914	6,557	17,805	983	768	13,055	203,208	−1,937	201,271
1915	6,636	16,726	863	1,026	13,133	204,420	−1,372	203,048
1916	7,020	19,613	1,186	1,200	14,021	218,233	+ 338	218,571
1917	8,389	30,064	1,442	1,622	15,656	243,684	+2,455	246,139
1918	10,366	39,377	1,602	2,484	17,140	266,783	+5,364	272,147
1919	12,002	43,461	1,719	4,380	18,278	284,498	+9,647	294,145

[1] For mode of estimation, see the text.

[2] The figures for this year are taken from the U. S. Census of Wealth, Debt, and Taxation.

in such a manner as to make it easy to separate out exactly the material desired, the study mentioned furnishes sufficient information to make it possible to approximate the totals sought. The material in the *Review* has been supplemented somewhat by figures derived from Mr. Walter R. Ingalls' recent book on the *Wealth and Income of the American People*. It is well to note the fact that Dr. B. M. Anderson's estimates [1] would indicate for the post-war years the existence of unfunded claims against European debtors much larger in amount than those shown by the Harvard studies. Since, however, many of these claims are of doubtful value, it seems wise to base our figures upon the lower rather than upon the higher estimates.

Table I shows that the valuation placed by the American people upon the physical wealth within the country has increased during each year of the decade. The rate of increase has varied, however, being much larger for the years since 1915 than it was for previous years. This more rapid increase presumably means that because of the increase in current prices people generally believed that the money-income from a typical piece of property would in the future be larger than it had been in the past.

The last column of the table shows that the inclusion of claims against foreign countries makes the nominal increase since 1916 in the value of the total wealth much greater than the increase in the value of the physical wealth alone. The present worth of these claims against foreign nations is at present, however, probably less than their face value because of the fear that payment may be defaulted when the amounts come due.

(To be concluded.)

[1] Published in the bulletins of the Chase National Bank.

THE INFLUENCE OF THE BUSINESS CYCLE ON CERTAIN SOCIAL CONDITIONS

By William F. Ogburn and Dorothy S. Thomas, *Columbia University*

The influence of economic changes on social conditions has for a long time been a subject of study for historians, economists, and sociologists. We know that changes in the economic system of a people are accompanied by profound social changes. Thus, the industrial revolution of the past century brought changes in political organization, in the family, the position of women, industrial classes, education, etc. Such effects are the materials back of the theory of the economic interpretation of history.

There is, however, another type of economic changes which also occasions social modifications. These changes are not the lasting changes in the economic order but are oscillatory changes of short duration. Thus, while time brings enduring change, there are also brief swings in economic conditions through prosperity and depression, around the line of general economic change. These fluctuations in business conditions occur over short intervals with some regularity and are usually referred to as business cycles. Do these fluctuations in business produce fluctuations in social conditions? Do we find relatively more births, deaths, marriages, and divorces in periods of business depression? Does crime and do other social phenomena fluctuate with the business cycle? Of course the fact that social statistics fluctuate simultaneously with indexes of the business cycle does not necessarily prove a causal influence, that is, that the economic changes produce the social changes. For instance, if the birth rate is correlated with the business cycle, such a change in the birth rate may not be due directly to the business cycle but may perhaps be due to the changes in the marriage rate, which may correspond to changes in the business cycle. Our first problem, however, is to determine the amount of concurrence in the fluctuations of certain social conditions with the fluctuations of business.

It is possible to measure the amount of this concurrence in several social phenomena, for in some cases we have series of statistics going back a number of years. Furthermore, during the last few years a great deal of success has been achieved in describing the business cycle, and there also exists the technique for measuring quantitatively the concurrence in fluctuations in time series. In the following pages,

therefore, we shall inquire to what extent certain data of marriages, divorces, births, deaths, and crime vary with the indexes of the business cycle. Our first step is to measure the cycles of business during recent years.

I

One difficulty in getting a measure of the business cycles to correlate with social statistics for so large and varied an area as the United States is the diversity of our economic life. Our economic life consists in the main of agriculture on the one hand, and of manufacturing, mining, and trade on the other. The products of agriculture are affected in large part by rainfall and climate; oscillations in crops were in early times referred to as good years and lean years, famines being the extremes of the lean period. The business cycle is a phenomenon more characteristic of the period of great manufacturing development. However, during the last half century in the United States there has been a fairly close relationship between economic welfare in agriculture and in manufacturing. Prosperity and depression in business affect the profits from agriculture, if not so much the volume of agricultural production.

The problem of procuring data which are representative of the state of manufacturing and commerce has been already satisfactorily met. Business failures, prices, volume of production, banking data, and employment are sufficiently widely representative.

Representative indexes must also have one other attribute. They must fluctuate concurrently. The analyses, particularly of Persons and of Mitchell, show that there are a number of economic series that reach their maximum when general prosperity is at its greatest height and reach their minimum when business depression is at its lowest depth. There are also various other series which, when measured in months, reach their maximum at various intervals preceding or following the peak of general business prosperity. Years of research by various economists have resulted in an excellent description in quantitative terms of the cycle of business based on a combination of these representative synchronous series.

We wished to take a curve of the business cycle already constructed but could find none covering a sufficient number of years. Most of the curves of business cycles are for very recent years. Persons has carried his data back to 1879, and Axe has constructed a curve by months to 1877, though he has not published an account of how his curve was constructed. Since it was desirable to have as long a period as possible, we have constructed a curve from 1870 to 1920. In

TABLE I

SOCIAL DATA TO BE COMPARED WITH BUSINESS CYCLES

	1	2	3	4	5	6	7	8
	Number of persons married during year per 1,000 population for certain states	Number of divorces granted per 100,000 population for U. S.	Number of deaths per 1,000 population for selected states	Number of deaths of infants under one year of age per 1,000 births for selected states	Number of deaths from tuberculosis per 100,000 population for selected states	Number of births, including still-births, per 1,000 population for selected states	Number of convictions for criminal offenses in New York state	Number of suicides per 100,000 population in one hundred American cities
1870....	18.60	28	14.63	134.1	246	24.41	2,151	....
1....	19.06	29	13.97	118.8	235	24.46	2,340	....
2....	19.01	30	17.36	157.9	253	25.61	2,298	....
3....	19.34	31	16.76	141.0	246	26.99	2,919	....
4....	18.58	32	15.25	133.1	227	26.09	3,368	....
5....	16.92	32	15.77	135.9	242	25.31	3,420	....
6....	15.92	33	15.35	127.2	227	24.67	3,451	....
7....	15.56	34	14.36	120.3	227	23.94	3,827	....
8....	15.82	34	13.88	116.0	218	23.57	3,829	....
9....	16.34	35	14.13	117.1	209	22.63	3,216	....
1880....	17.42	39	14.94	125.4	215	22.38	2,847	....
1....	17.96	40	15.83	135.0	226	22.38	2,923	....
2....	18.74	42	15.24	125.0	217	22.74	2,887	....
3....	18.68	43	15.29	119.0	219	23.57	2,474	....
4....	17.42	42	15.10	132.3	217	23.34	2,315	....
5....	16.76	42	14.88	126.8	211	23.14	2,491	....
6....	17.28	44	14.61	131.1	207	23.07	2,860	....
7....	17.92	47	15.55	129.5	200	24.06	3,301	....
8....	17.76	48	16.17	135.0	201	24.37	3,243	....
9....	17.96	52	15.21	128.8	184	24.47	3,156	....
1890....	18.06	53	15.79	130.9	191	24.74	3,364	....
1....	18.40	55	15.96	133.2	174	25.38	3,607	....
2....	19.78	56	16.65	135.3	177	24.85	3,202	....
3....	18.20	56	16.23	136.1	171	25.23	3,283	....
4....	16.58	55	15.14	136.0	167	24.24	2,940	....
5....	17.50	58	15.45	134.4	171	24.22	4,468	....
6....	17.50	61	15.36	135.1	162	25.07	3,768	....
7....	16.66	62	14.42	124.0	153	24.17	4,523	....
8....	16.64	65	15.31	136.8	151	23.75	3,567	....
9....	17.34	69	16.00	137.1	146	22.68	3,861	....
1900....	17.80	73	16.69	156.8	144	23.09	4,116	15.4
1....	18.00	79	15.68	136.0	140	22.40	4,431	15.6
2....	19.58	78	14.96	132.2	130	22.56	4,516	16.7
3....	18.88	81	15.46	135.2	126	22.56	3,931	18.0
4....	17.78	81	15.11	130.0	132	22.74	4,685	18.7
5....	18.48	82	15.45	139.2	127	22.44	4,942	18.2
6....	19.48	86	15.62	136.5	123	24.47	5,143	16.8
7....	19.98	..	15.76	127.1	123	24.96	5,529	18.8
8....	17.56	..	15.02	125.4	116	25.62	7,351	21.5
9....	18.38	..	14.71	123.7	112	24.66	6,857	20.4
1910....	19.08	..	15.53	127.9	113	24.95	6,046	19.6
1....	19.22	..	14.81	112.9	108	24.99	6,657	20.4
2....	19.38	..	14.49	109.2	102	25.25	7,336	19.4
3....	19.64	..	14.58	106.5	101	25.47	7,765	19.7
4....	19.78	..	14.15	101.4	101	25.59	9,088	20.9
5....	19.18	..	13.98	95.3	102	25.63	10,158	20.8
6....	21.56	..	14.91	97.3	105	26.07	7,218	18.0
7....	22.22	..	14.93	92.3	107	26.39	7,930	16.7
8....	16.80	..	18.90	100.1	115	26.55	7,244	14.6
9....	21.00	..	13.43	86.3	94	23.94	8,047	14.3
1920....	23.06	..	14.02	88.8	84	25.04	6,856	12.3

TABLE II

CYCLES OF BUSINESS AND SOCIAL CONDITIONS

	1	2	3	4	5	6	7	8	9
	Cycles[1] of business indexes	Cycles of marriage rates	Cycles of divorce rates	Cycles of death rates	Cycles of infant death rates	Cycles of tuberculosis death rates	Cycles of birth rates	Cycles of crime rates	Cycles of suicide rates
1870	−0.15	+0.25	−0.91	−1.44	−0.20	+0.26	−2.33	+0.33	.....
1	+0.72	+0.76	−0.46	−2.28	−2.09	−0.76	−1.70	−0.24	.....
2	+1.15	+0.90	−0.07	+3.00	+3.34	+1.38	+0.45	−1.14	.....
3	+0.91	+1.18	+0.23	+2.23	+1.19	+0.81	+2.88	+0.02	.....
4	+0.25	+0.58	+0.49	+0.07	+0.23	−1.07	+2.12	+0.71	.....
5	−0.65	−0.88	−0.29	+0.95	+0.74	+0.83	+1.46	+0.56	.....
6	−1.18	−1.76	−0.20	+0.40	−0.38	−0.57	+0.94	+0.41	.....
7	−1.08	−2.03	−0.20	−1.07	−1.26	−0.34	+0.21	+1.19	.....
8	−1.63	−1.74	−1.01	−1.77	−1.79	−1.07	−0.07	+1.15	.....
9	−0.95	−1.21	−1.04	−0.95	−1.57	−1.82	−1.25	−0.23	.....
1880	+0.55	−0.15	+1.47	−0.12	−0.36	−0.83	−1.46	−1.03	.....
1	+0.73	+0.42	+1.30	+1.26	+1.03	+0.83	−1.39	−0.79	.....
2	+0.93	+1.18	+1.92	+0.30	−0.36	+0.13	−0.80	−0.75	.....
3	+0.52	+1.15	+1.63	+0.33	−1.21	+0.76	+0.42	−1.65	.....
4	−0.31	−0.02	−0.23	−0.02	+0.69	+0.94	0.00	−1.94	.....
5	−0.82	−0.63	−0.94	−0.47	−0.11	+0.63	−0.45	−1.51	.....
6	−0.19	−0.13	−0.85	−0.98	+0.47	+0.60	−0.76	−0.36	.....
7	+0.61	+0.48	+0.26	+0.33	+0.20	+0.18	+0.45	+0.85	.....
8	+0.53	+0.32	−0.20	+1.09	+0.92	+0.86	+0.63	+0.76	.....
9	+0.36	+0.50	+1.34	−0.49	−0.04	−0.88	+0.38	+0.56	.....
1890	+0.96	+0.56	+0.91	+0.19	+0.18	+0.65	+0.35	+1.06	.....
1	+0.70	+0.88	+1.01	+0.21	+0.42	−1.12	+0.42	+1.64	.....
2	+0.93	+2.14	+0.52	+1.23	+0.60	−0.05	−0.10	+0.43	.....
3	+0.02	+0.61	−0.59	+0.65	+0.60	−0.29	+0.69	+0.42	.....
4	−1.37	−0.96	−2.12	−0.95	+0.42	−0.47	−0.45	−0.60	.....
5	−0.52	−0.13	−1.53	−0.47	+0.07	+0.91	−0.17	+2.68	.....
6	−1.23	−0.20	−0.98	−0.56	0.00	+0.26	+1.32	+0.71	.....
7	−1.15	−1.03	−1.50	−1.91	−1.62	−0.47	+0.35	+1.96	.....
8	−0.73	−1.13	−1.01	−0.56	−0.11	−0.08	+0.07	−0.45	.....
9	+0.12	−0.53	−0.16	+0.53	−0.63	−0.18	−1.18	−0.26	.....
1900	+0.21	−0.20	+0.62	+1.63	+2.06	+0.18	−0.21	−0.17	−0.27
1	+0.19	−0.10	+2.28	+0.19	−0.43	+0.16	−1.01	+0.02	−0.52
2	+0.60	+1.26	+0.72	−0.81	−0.70	−1.04	−0.24	−0.29	+0.12
3	+0.26	+0.53	+0.91	+0.02	−0.07	−1.15	+0.14	−1.61	+1.08
4	−0.37	−0.56	−0.13	−0.44	−0.52	+0.73	−0.14	−0.81	+1.19
5	0.00	−0.05	−0.68	+0.19	+1.01	+0.39	−1.35	−0.82	−0.12
6	+0.52	+0.75	−0.13	+0.56	+0.96	+0.21	+0.90	−0.95	−2.20
7	+0.90	+1.05	.....	+0.88	−0.04	+0.83	+0.97	−0.72	−0.54
8	−0.97	−1.20	.....	−0.14	+0.11	−0.10	+1.35	+1.19	+1.79
9	+0.08	−0.60	.....	−0.48	+0.25	−0.44	−0.42	+0.24	+0.31
1910	+0.46	−0.12	.....	+0.91	+1.32	+0.34	−0.38	−0.97	−0.81
1	−0.17	−0.13	.....	−0.07	−0.52	−0.34	−0.63	−0.53	−0.10
2	+0.26	−0.13	.....	−0.42	−0.63	−1.30	−0.48	−0.05	−1.00
3	+0.34	−0.07	.....	−0.14	−0.58	−1.12	−0.35	+0.20	−0.52
4	−0.66	−0.10	.....	−0.65	−0.88	−0.70	−0.24	+1.36	+1.14
5	−0.70	−0.73	.....	−0.77	−1.37	−0.08	−0.21	+2.27	+1.85
6	+0.62	+1.06	.....	+0.93	−0.38	+1.04	+0.45	−0.68	−0.35
7	+1.08	+1.43	.....	+1.14	−0.63	+1.88	+1.04	−0.02	−0.48
8	+1.25	−3.11	.....	.....	+1.68	+4.27	+1.46	−0.64	−1.46
9	+0.35	+0.10	.....	−1.12	−0.25	−1.07	−1.80	+0.26	+0.46
1920	+0.81	+1.54	.....	+0.07	+1.19	−0.96	+0.07	−0.74	+0.50

[1] The cycles are in units of the standard deviation.

working out a single series to describe the business cycle we have chosen to combine the following series:

1. Wholesale prices, 1870–1915.[1]
2. Commercial failures, 1870–1920.[2]
3. Bituminous coal production, 1870–1920.[3]
4. Pig iron production, 1870–1920.[4]
5. Railroad freight ton mileage, 1882–1920.[4]
6. Bank clearings outside New York, 1881–1915.[5]
7. Employment in Massachusetts, 1889–1920.[6]
8. Railroad mileage constructed, 1870–88.[7]
9. Imports, 1870–88.[8]

These series have all been studied by others, and their yearly fluctuations are shown to have a high correlation [9] and to represent widely different types of economic phenomena. They are also probably sufficient in number to average out certain errors due to inadequacies in fitting trend lines and to such deviations of particular series from the true business cycle as may be found here and there.

The next step was to determine the cycles for each series. The data for most of these nine series when plotted showed a general upward movement for the whole period, with small fluctuations up and down around the line of the general upward movement. (A similar upward movement is seen in the curve of divorce rates shown in Chart III.) To each series lines were then fitted which appeared to describe the general movement. These lines are called the trend lines.[10] The actual data deviated in each year above or below these trend lines. (In Chart III, showing divorce rates, similar trend lines and deviations of the data from the trend lines are shown.) These deviations of the actual data from the trend for each year were computed in percentages of the trend data for the respective years. Then each percentage

[1] *U. S. Bureau of Labor Statictics, Bulletin 149*, p. 179; and *Monthly Labor Reviews*.

[2] The ratio of commercial failures to firms in business. Dun's Review. *Statistical Abstract of the United States*. Dun's figures of the number of firms in business.

[3] *U. S. Geological Survey, Mineral Resources of the U. S.*, 1917, p. 924 and later releases.

[4] *Statistical Abstract of the U. S.*

[5] *Commercial and Financial Chronicle*.

[6] Indexes of employment in manufacturing industries in Massachusetts. Ralph G. Burlin, "Three Decades of Employment Fluctuation," *The Annalist*, vol. 18, pp. 387–88, Oct. 24, 1921.

[7] *World Almanac*, 1922, p. 184.

[8] Value of Imports. U. S. National Monetary Commission, Statistics for the United States, 1867–1909.

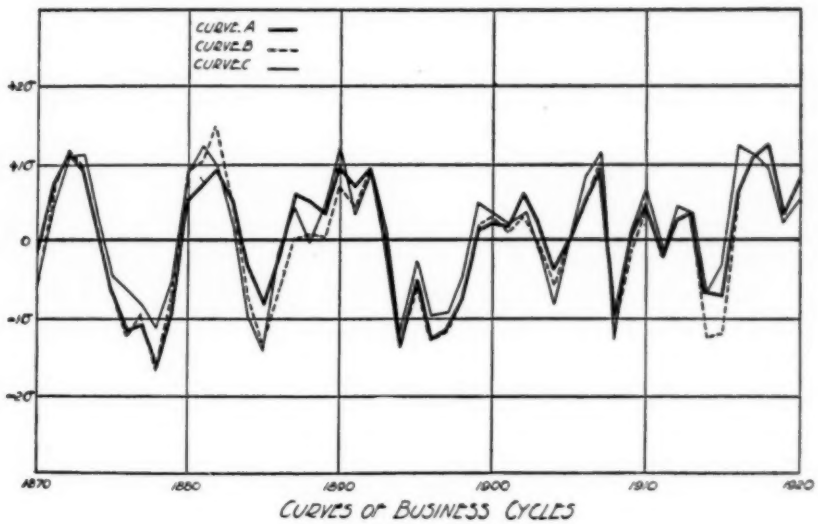
[9] Warren M. Persons, "The Construction of a Business Barometer," *The Amer. Economic Rev.*, vol. VI, No. 4, Dec. 1916; and *Indices of General Business Conditions*.
The Review of Economic Statistics (various issues).

[10] The trend lines for the various series are the following. The origins for these equations and all others listed are at the midyear of the period unless otherwise stated.

1. Wholesale prices, 1870–96, $y = 96.57 - 2.93x + 0.06636x^2$; and, 1897–1915, $y = 90.4 + 1.847x - 0.07335\,x^2$.
2. Commercial failures, 1870–1920, $y = 0.966 - 0.0043\,x$.

deviation was divided by the standard deviation of these percentage deviations for the particular series. The results were the cycles for the particular series in terms of their respective standard deviations as units. (Similar cycles for the divorce data are seen in column 3 of Table II.) The arithmetic mean, unweighted, was then found for the cycles of the nine series. The result is a single series describing the business cycle for the period and is seen plotted as curve A in Chart I. The indexes of the cycles are listed in column 1 of Table II.

In constructing this curve showing the fluctuations of business for



CURVES OF BUSINESS CYCLES

CHART I

the past fifty years, the chief methodological difficulty was in selecting the equations of the trend lines that seemed to describe best the general movement of the particular series. As there was no mechanical test to show which particular line best described the true trend of the data, it was largely a matter of judgment of the eye. For instance, one investigator might think that the trend of wholesale prices from

3. Bituminous coal production, 1870–1892, $y = 7760.8 + 631.22x + 19.41x^2$; 1902–14, $y = 37374 + 1673x - 54x^2$; and 1914–20, projected.
4. Pig iron production, 1870–94, $y = 4218.34 + 306.02 + 6.53x^2$; 1894–1904, $y = 12888.09 + 1140.96x$ 1904–14, $y = 24298.81 + 785.79x$; and 1914–20, projected.
5. Freight ton mileage, 1882–1914, $y = 120.88 + 8.076x + 0.2009x^2$; and 1914–20, projected.
6. Bank clearings outside New York, 1881–1915, $y = 31389 + 1982.54x + 56.23x^2$.
7. Employment, 1889–1905, $y = 62.47 + 1.818x + 0.1644x^2$; 1905–15, $y = 95.91 + 1.35x$; and 1916–20, projected.
8. Railroad mileage constructed, 1870–88, $y = 5754.37 + 236.3x$.
9. Imports, 1870–88, $y = 5691 + 108x$.

1870 to 1896 was that best described by a straight line, and another investigator might prefer a parabola.

In order to get around this difficulty of individual bias, which as a source of error, however, may be limited, we decided to check our results by constructing another curve of the business cycle by computing the cycles of each series from trend lines consisting of nine-year moving averages.[1] This was done, and the result is curve B in Chart I. It is seen to be remarkably similar to curve A, the coefficient of correlation of the two curves being +0.95.

Because of the fact that there may be a variation in preference on the part of different investigators in choosing equations to describe trends, it is of value to compare our curve of business cycles, curve A in the chart, with the curve constructed by Axe. Axe's curve is not constructed from identically the same series,[2] and it is for intervals of a month. It was reduced to a yearly basis by adding the monthly cycle indexes and dividing by twelve. As this curve goes back only to 1877, we pieced it out by joining on a cycle from 1867 to 1877 constructed from several economic series available for those years.[3] The resulting curve, thus extended, is plotted as curve C in Chart I. It is quite similar to curve A, the coefficient of correlation being +0.92.

From the foregoing considerations, then, we think that the cycle

[1] The moving averages were plotted at the midyear of each nine-year period. The trend lines of moving averages extended over the following years for the various series:

1. Wholesale prices, 1867–1912.
2. Commercial failures, 1868–1914.
3. Bituminous coal production, 1867–1916
4. Pig iron production, 1867–1916.
5. Railroad freight ton mileage, 1887–1916.
6. Bank clearings outside New York, 1884–1911.
7. Employment in Massachusetts, 1893–1916.
8. Railroad mileage constructed, 1867–86.
9. Imports, 1871–92.

[2] Axe's curve was published in the *New York Evening Post*, Oct. 17, 1921, in an article by Wesley C. Mitchell. The curve was not described, the trend lines not given, nor the years covered by the various series. The series combined in the curve were weighted with the following weights:

Bank clearing outside New York	25
Pig iron production	20
Railroad traffic	15
Failures	10
Copper production	5
Cotton consumption	10
Coal production	5
Commodity prices	10
	100

[3] The segment from 1867 to 1877 was constructed by averaging the cycles derived from straight-line trends for the following series: Railroad mileage constructed; imports and exports (fiscal years); immigration (fiscal years); pig iron production; bituminous coal production; commercial failures; wholesale prices; cotton consumption. The standard deviations for this segment are based on yearly data, while for the series in Axe's curve they are based on monthly data. There is, for this reason, perhaps some error in joining the two curves, but it does not appear to be large.

series in column 1 of Table II is a sufficiently satisfactory measure of the business fluctuations from 1870 to 1920 to use in correlation with the data of certain social phenomena.

II

For a study of the variations in marriage rates the only data that have been collected for the United States as a whole are from 1866 to 1906. Since it was desirable to have a longer record, we have collected the figures for the number of persons married during the year for the period 1870–1920 for the states for which satisfactory statistics were available. These states are Connecticut, Massachusetts, Michigan, New Hampshire, Rhode Island, and Vermont. The rates [1] for these states are listed in column 1 of Table I. A parabola [2] seems to describe the general movement of the marriage rates as seen in Chart II. The fluctuation of these marriage rates around the trend appears to be, in general, concurrent with the cycles of business indexes, as is seen by comparing the marriage cycles listed in column 2, Table II, with the business cycles listed in column 1, the coefficient of correlation being +0.66. Although in general the marriage rate increases in prosperity and diminishes in depression, this is rather noticeably not true in the year 1918. The marked drop in the marriage rate in this very prosperous year is thought to be due to the extraordinary conditions of war time. If we omit from the correlation table the data for the year 1918, the correlation becomes +0.87. When the cycles of marriage rates are computed from a trend of nine-year moving averages their correlation with the business cycles for 1874–1916 is +0.81.

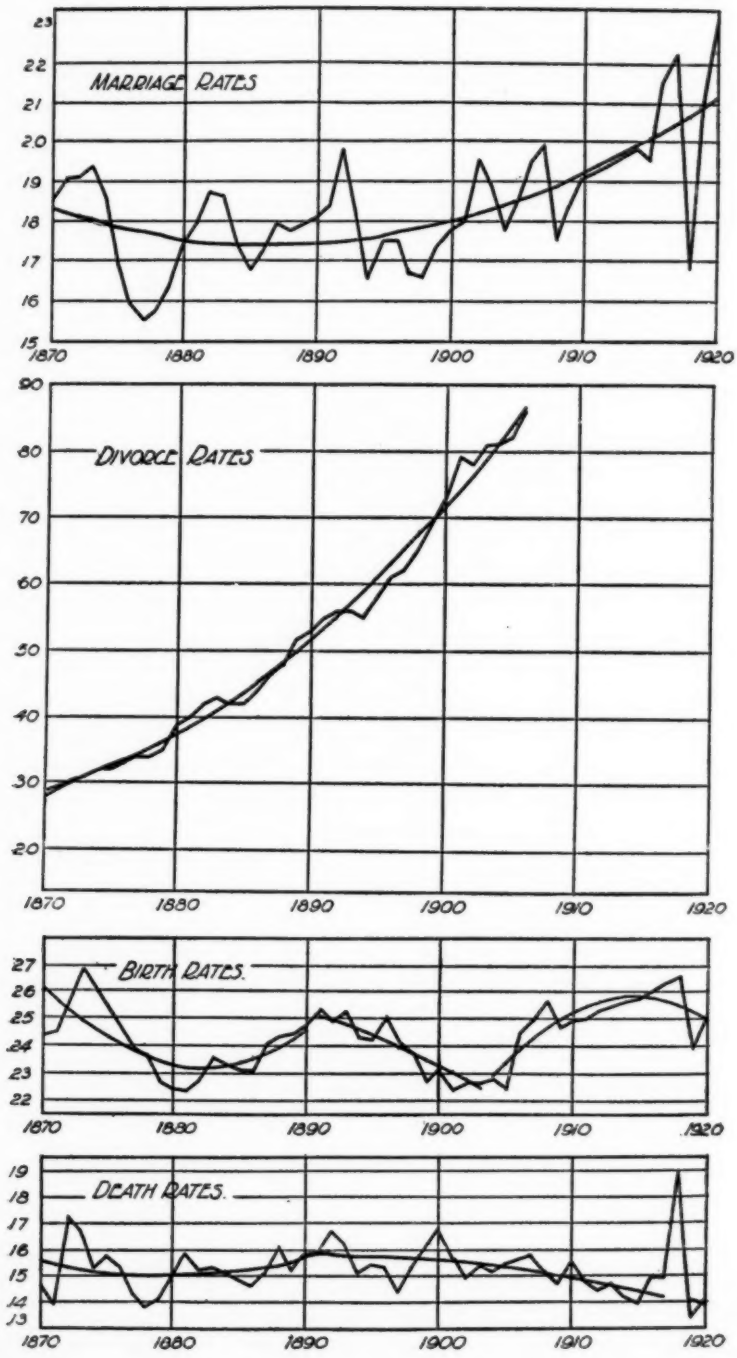
Similar results have been found by others. In 1901 Hooker obtained a coefficient of correlation of +0.86 between the marriage rate in England and Wales and the amount of foreign trade for the period 1861–95, the cycles being measured from seven-year moving averages.[3] For the United States, Davies found a correlation between the marriage rate and wholesale prices, 1887–1906, of +0.67.[4] This checking of results from different data by different investigators leaves no doubt as to the fact that the number of marriages fluctuates with business conditions.

[1] The population of these states, used in computing the rates, was found by interpolation for the intercensal years, on the assumption of a constant rate of change. During the last decade when the changes in population were somewhat unusual, the results of the state censuses helped in making the interpolation.

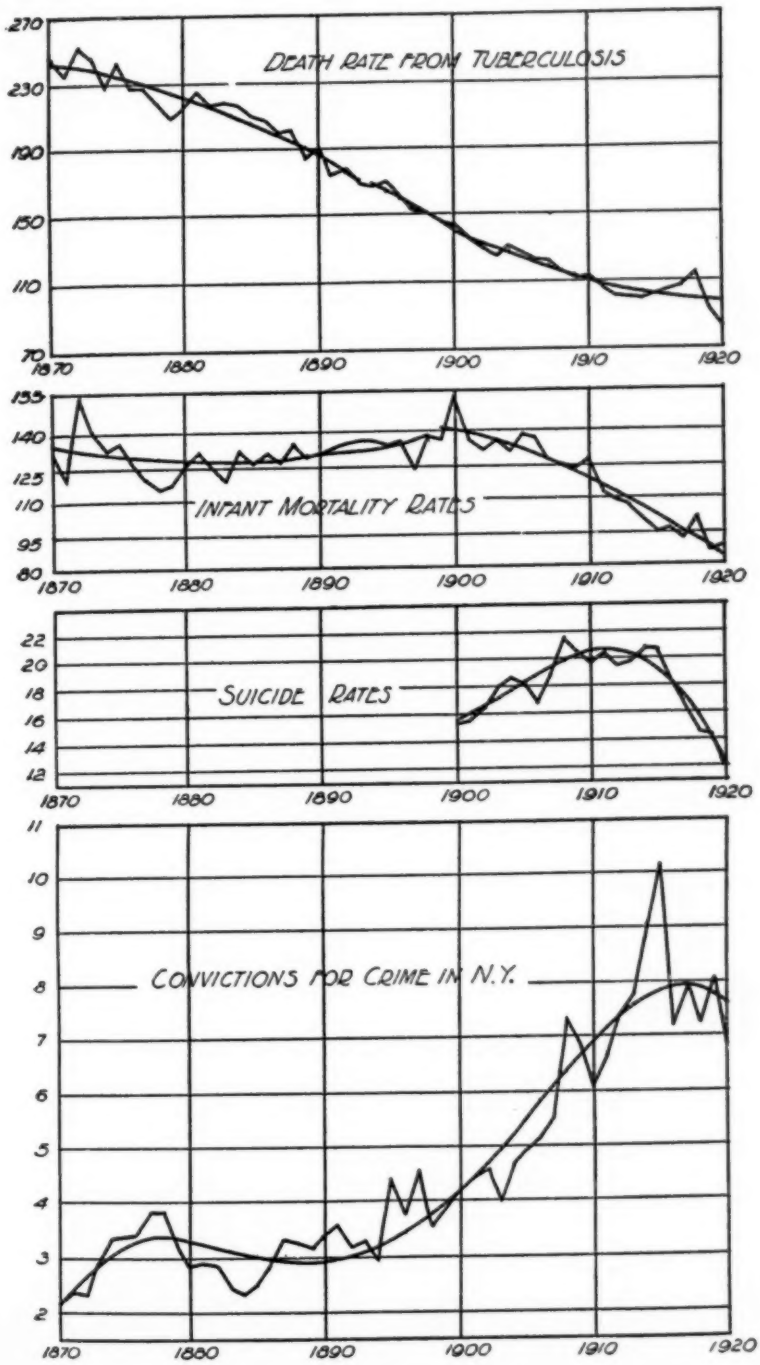
[2] $y = 17.65 + 0.055\,x + 0.0032\,x^2$.

[3] R. H. Hooker, "On the Correlation of the Marriage Rate with Foreign Trade," *Jour. of the Royal Statis. Soc.*, vol. LXIV, p. 485.

[4] George R. Davies, "Social Aspects of the Business Cycle," *Quar. Jour. of the Univer. of N. D.*, vol. XII, No. 2, Jan., 1922.



CHARTS II, III, IV, AND V



CHARTS VI, VII, VIII, AND IX

That the marriage rate should be greater when business is good and less when business is bad appears to be what one would expect. Yule thinks that one reason for the very large degree of correlation is probably the fact that the non-occurrence of the event in a business depression means in many cases only a postponement until business prosperity returns. The changes in the marriage rate seem to be practically simultaneous with changes in the business cycle. When the correlation is made between the indexes of the business cycle and changes in the marriage rates, not of the same year but of the following year, the coefficient of correlation (omitting the data for 1918) is +0.62, smaller than the coefficient when the correlation is made without the assumption of a one-year lag. Hooker finds that the correlation is a maximum with a lag of about a third of a year. The correspondence in the fluctuations of the marriage rate and the business cycle seem to be a little closer for the earlier years than for the later year, from both the British and the American data.

III

That the divorce[1] rate is influenced by business conditions was noted by Willcox[2] as early as 1893. The curve of divorce rates for the United States from 1866 to 1886 showed low divorce rates in the periods 1873–79 and 1884–86, which Willcox observed were periods of depression in trade. The similarity in the drops in the curve of divorce rates and the curve of trade was so close as to lead to the conclusion of a causal relationship.

Since the publication of Willcox's article, the divorce statistics for the United States have been extended to 1906. There has been a marked increase in the divorce rate, as is seen in the Chart III. Chart III also shows the trend line describing the upward movement.[3] The fluctuations around this trend line correspond quite closely to the fluctuations of the business cycles, the correlation for the forty years, 1867–1906, being +0.70.[4]

The tendency to secure more divorces in prosperity and fewer divorces in business depression is quite marked, and this conclusion is perhaps surprising. The reason is not clear, although the economic argument is clearer than the psychological. The fact that divorces are expensive, involving lawyers' and court fees and perhaps alimony, may

[1] We are indebted to Miss Helen Mack for assistance in the study of divorce rates and the business cycle.

[2] Walter F. Willcox, "A Study in Vital Statistics," *Polit. Sci. Quar.*, vol. VIII, No. 1.

[3] $y = 46.685 + 1.542\,x + 0.0289\,x^2$.

[4] The business-cycle curve used in this correlation was constructed from nine-year moving-average trends.

be the reason for relatively more divorces in times of business prosperity. It would be interesting to know whether there are also more desertions in periods of prosperity. It would also be interesting to know what psychological factors are involved in decreasing the divorce rate in times of business depression.

On account of the fact that time is involved in the court procedure of granting divorces, we might be led to expect a lag in the variations in the divorce rate corresponding to the business cycle. The correlation is, however, lower with a one-year lag in the divorce rates, being +0.58.

We have been able to procure the divorce rates for thirteen states [1] through 1920. The correlation between the business cycles for the United States and the divorce cycles for the thirteen states is lower (+0.33) than the correlation between the former and the divorce cycles of the United States as a whole for the shorter period. The lack of correspondence between the divorce cycles of the thirteen states and the business cycles appears to be greater for the earlier years, however, than for the later years. Also, from an inspection of the curves of divorce rates as published in the census volumes for separate sections of the United States, such as the South Atlantic States and the North Central States, it appears that there is a less close correspondence in fluctuations with the business cycle than there is for the nation as a whole. Just why these samples should show lower correspondences than the whole, we do not know. Possible causes may be changes in laws, migrations, changes in residence, or the influence of crop cycles.

IV

Statistics of the annual death rate for the registration area go back only to 1900. We were able to obtain the death rates from 1870 to 1920, however, for the same states for which we secured marriage rates. The fluctuations in the curve of these death rates seem to correspond somewhat with the business cycles. The correlation [2] is found to be positive and fairly high, $r = +0.57$, and with cycles from nine-year moving averages, $r = +0.63$. This is a surprising result, as one would guess that if there were any correlation at all between business conditions and death rates it would be negative, that is, there would be relatively more deaths in business depression and fewer in business prosperity. Such an inference would be drawn, for instance, from the studies of the Children's Bureau, Washington, D. C.,

[1] Conn., Ind., Ia., Me., Mass., Mich., N. H., Ohio, R. I., S. D., Utah, Vt., and Wis.

[2] The trend lines for the death rates from which the cycles were computed are, for 1870–90, $y = 15.01 + 0.0035\,x + 0.0062\,x^2$, and for 1891–1920 (omitting 1918), $y = 15.33 - 0.0654\,x - 0.0022\,x^2$.

which have shown that when the earnings of the father are low, the infant death rates are high. We are also told that pulmonary tuberculosis is a disease of poverty. The impression that disease is more prevalent in conditions of poverty would lead one to expect more deaths in business depression.

Assumptions of lags do not clarify the matter. With a one-year lag in the death rate the correlation is +0.49, and with a two-year lag it is +0.03. If we assumed a four- or five-year lag or longer in the influence of the business cycle on the death rate, we should probably get a negative correlation. But what basis is there for such an assumption? Such an assumption would be quite unjustified in the case of infant death rates. Yet the curve of infant death rates for these states is quite similar to the curve of general death rates. Yule has found a correlation of +0.77 between the general death rates in England and Wales and the infant death rates.[1]

The infant mortality rate shows about the same positive correlation with the business cycle as does the general death rate, +0.42, for the same states and for the same period.[2] The correlation, when the trend is nine-year moving averages, is +0.37. And with a one-year lag in the infant mortality rates the correlations are, for these types of trends, +0.43 and +0.29. The infant mortality rates, then, like the general death rates, show the strange result of increasing in prosperity and decreasing in depression.

If the registration bureaus were in the habit of collecting and registering more records in good times and fewer in bad times, this positive correlation would be explained; but persons familiar with the administration of vital statistics assure us that there is no such variation in the registration of death records.

We know that the filing of death records for all deaths does not occur. It has been a long, hard struggle to induce the various states to keep records sufficiently complete to entitle them to be included in the registration area. But even if the statistics of deaths are much less than 100 per cent complete, the partial records might quite conceivably show much the same cyclical fluctuation around a trend that they would if the records were complete. On the other hand, errors in the record may be due to various causes.

It may be that the death rates for the registration area since 1900 are more accurate than the death rates for the selected group of states from 1870 to 1900. We have therefore correlated the death rate for

[1] G. Udny Yule, *Introduction to the Theory of Statistics*, Chap. V, p. 198.

[2] The trend line for the infant mortality rate from which the deviations were measured for correlation with the business cycle is, for 1870–98, $y = 127.47 + 0.067x + 0.0466x^2$; and, for 1898–1920, $y = 122.04 - 2.73x - 0.072x^2$.

the United States registration area, 1900–20, with the business cycle for that period with the same results, $+0.44\pm0.12$ for the general rates, and $+0.41$ for the infant mortality rates.[1]

On account of these unexpected results it is desirable to see if they are borne out by statistics for other countries. We have not found any published results of correlations by other investigators of death rates and business conditions. We did, however, examine the mortality rates in England and Wales where the registration of vital statistics has been exceptionally satisfactory. In the absence of a curve of business cycles for England we used as our index of business conditions the amount of foreign trade.[2] The correlation, for the period 1870–1914, of foreign trade with the general death rate is $+0.02$, and with the infant mortality rate is -0.09. These results increase our skepticism regarding the existence of a significant correlation between death rates and the business cycle.

Even if there is no correlation of the business cycle with the general death rate, there might be a correlation with specific death rates, although inspection of the curves of some of the classifications of death rates since 1900 does not encourage such an expectation. For the United States, the fact that few states have records going back to 1870 and that only a small number of cases of deaths from specific diseases is recorded makes an inquiry somewhat doubtful. We have, however, correlated the cycles[3] of death rates from tuberculosis of the lungs for certain states[4] with the cycles of business, for the period 1870–1920, and find a correlation coefficient of $+0.32$. If the year 1918 is omitted the correlation becomes $+0.24$, and with a one-year lag it is $+0.16$. For the United States registration area, 1900–20, the correlation is $+0.193$; omitting 1918, it is -0.05.[5] The relationship of death rates from pulmonary tuberculosis to the business cycle is much the same as that of the general death rate.

The suicide rate would be expected, we think, to vary with business prosperity and business depression, and so it does. We have taken the suicide rate as computed by Hoffman[6] for one hundred cities of the United States for 1900–20 and correlated the suicide cycles[7] with

[1] The trend for the general death rate, 1900–20, omitting 1918, is $y=14.69-0.192\,x+0.00025\,x^3$, and for the infant mortality rates, determined by dividing the deaths by the population, is, 1900–20, $y=271.5-6.86\,x-0.05\,x^2$.

[2] The trend line for the foreign trade is $y=716.4+14.5\,x+0.596\,x^2$. The trends for other British data were taken from nine-year moving averages.

[3] Trend, 1870–94, $y=216-3.14\,x-0.72\,x^2$; and 1894–1920, $y=119.2-2.8\,x+0.086\,x^3$.

[4] Mass., Mich., N. H., and R. I.

[5] Trend $y=142.7-3.4\,x+0.034\,x^2$.

[6] Frederick L. Hoffman, "Suicide Record for 1920," *Spectator*, March 9, 1922.

[7] The suicide cycles were measured from the trend line $y=20.35+0.171\,x-0.0656\,x^2-0.00348\,x^3$.

cycles of business conditions for the same period, and we find a correlation of -0.74 ± 0.07.

From the inquiry, as thus far conducted, into a possible correlation between death rates and business cycles, we do not draw the definite conclusion of a correlation, except in the case of suicides. The evidence for the United States points toward the conclusion that there are somewhat greater death rates in prosperity than in depression; but the British data do not bear out such a conclusion. Although it seemed probable that there would be a negative correlation between death rates and the business cycle, it should be remembered that there are other factors affecting the fluctuations of death rates from year to year. Such factors are climate, health education campaigns, developments of preventive medicine, and epidemics. In a period of fifty years there are only a very few cycles, and if there is an economic influence it might be obscured by variations in other factors, although it could be uncovered by partial correlations if we could procure series of data for the other factors.

V

For statistics of births in the United States the birth registration area was created in 1915, fifteen years later than the publication of annual deaths from the death registration area. However, we were able to get birth statistics from 1870 to 1920 from the same states from which we obtained mortality statistics. These statistics of birth rates are shown plotted in Chart IV. Looking at this curve we observe that there would be a little more than two cycles if the trend be assumed to be a straight line, which would give little or no correlation with the business cycles. If we assume a trend with two or three bends in it, then we shall get more numerous cyclical fluctuations. The chart shows the trend lines we have fitted.[1] The moving averages of nine years follow very much the same course as these trend lines. The correlation of the fluctuations of the birth rate with the indexes of business is $+0.06$; when the birth rate fluctuations are measured from the line of nine-year moving averages the correlation is $+0.04$. The birth rate for England and Wales likewise fails to show a high positive correlation. When correlated with the amount of foreign trade, the British birth rates, 1874–1910, yield a correlation of -0.31.

One expects a positive correlation between the birth rate and the business cycle, if for no other reason than the fact that there are more marriages in prosperity and fewer in depression. But one also expects such a possible positive correlation to appear by comparing the index

[1] Trends: 1870–90, $y = 23.37 - 0.0836\,x + 0.0196\,x^2$; 1890–1904, $y = 23.93 - 0.219\,x - 0.0041\,x^2$; 1904–20, $y = 25.62 + 0.135\,x - 0.0268\,x^2$.

of the business prosperity not, say, of a particular year with the birth rate of the same year, but with the birth rate of the year following. Making such a correlation on the assumption of a one-year lag, we find for the selected states, 1870–1920, a correlation of $+0.33\pm0.07$; for England and Wales, 1874–1910, it is $+0.15\pm0.11$. Our correlations indicate, therefore, that there is a slight tendency for birth rates to increase in prosperity after a year's lag and to decrease in depression. This may be due in part to the fact that marriages are so highly correlated with business conditions.

VI

It has been said that in periods of acute business depression and unemployment the prisons are filled. In order to measure the correlation between crime and the business cycle records are needed extending over a long period of time. The Secretary of State of New York publishes such a record of the number of convictions for criminal offenses in Courts of Record. Several other states are reported as having such a record, but we have been unable to secure another state record for an unbroken series of years. Regarding these statistics of convictions, Robinson, in his *Criminal Statistics of the United States*, observes that in no state are the records complete. The statistics are sent in from the different local units, but somewhat irregularly. Although the series for New York State is not complete it is the best available, and we decided to compare the fluctuations of this series of crime statistics with the business cycle.

Observation of this curve of crime statistics, as shown in Chart IX, and its fluctuations around the trend line[1] shows that in most of the depressions the number of convictions is above the normal, as indicated by the trend, and in most of the periods of prosperity the number of convictions is less. The coefficient of correlation is -0.35 ± 0.08; when the trend for the data on convictions is for nine-year moving averages the correlation is the same, -0.32. With a one-year lag the coefficient of correlation is smaller, -0.24.

The conclusion that there is an increase in convictions for crime in business depression is corroborated by Davies,[2] who correlated the annual admissions to New York State prisons, 1896–1915, with wholesale prices and found a correlation of -0.41 ± 0.13.

The Secretary of State of New York in his report publishes an analysis of the number of convictions, and one of the series is the number of convictions for offenses against the person, exclusive of offenses against

[1] $y = 331.93 + 12.633 + 1.1035\ x^1 - 1.002512\ x^2 - 0.00138\ x^4$.

[2] *Loc. cit.*, p. 111.

property with violence. It is interesting to inquire whether such offenses against the person are correlated with business conditions. The coefficient of correlation is negative, though small, -0.12 ± 0.09.

Our conclusion is, therefore, that although the records of crime statistics are not wholly satisfactory, there does appear to be some negative correlation between convictions for crime and the business cycle, and this conclusion has been corroborated by another investigation from different data.

THE METHOD OF MONTHLY MEANS FOR DETERMINATION OF A SEASONAL VARIATION

By William L. Hart, *University of Minnesota*

1. INTRODUCTION

Many of the mathematical processes used in statistical analysis are of such frequent application and are, relatively, so ancient in their origin that one ceases to think of the reasons for their well-known validity. When a new process is invented, however, it should be subjected to close scrutiny to determine the sphere in which its application is valid. The present paper deals with two methods which have been used for the determination of the seasonal variation in certain statistical data of economics. Arguments are presented against one method,[1] which is relatively complicated in its numerical details, and a complete logical foundation is given for a second method,[2] which involves merely the formation of monthly means.

Before considering the particular problems of this paper it is pertinent to decide on suitable criteria for testing the validity of a mathematical process used in statistical analysis. In the field of pure mathematics we may state certain definite hypotheses and, by logical reasoning, derive certain equally definite conclusions. It is realized, after very brief reflection, that most of the well-established mathematical methods of statistics have been taken over bodily from corresponding problems already solved in the field of pure mathematics. Such statistical methods have perfectly defined spheres of usefulness. We are usually able to state that if our statistical problem, when couched in mathematical terms, satisfies a given set of conditions, then our particular method leads us to conclusions, the accuracy of which is dependable. Many times, moreover, we are also able to state that even when the given set of conditions is not satisfied by our data, nevertheless the conclusions obtained by our method are the best, of a given type, that could possibly be obtained by *any* method.

To illustrate the preceding paragraph, consider the method of least squares for determining a line $y=at+b$ to fit a set of points in a plane containing the rectangular (y, t) axes. This set of points may be considered as the graph of a time series, a table of the values of a variable quantity y for a sequence of values of the time represented by t. The

[1] Persons, *Rev. of Economic Stat.*, Jan., 1919, p. 5.

[2] E. W. Kemmerer, *Seasonal Variation in the Demand for Money and Capital in the United States*, Report of the National Monetary Commission (1910).

following mathematical theorem is the logical basis for our statistical method in the present type of problem:

If the set of points actually lies on a straight line, this is the line which is given by the method of least squares. Moreover, if the points do not lie on a straight line, that line which we obtain by our method is such that the sum of the squares of the distances (measured parallel to the y axis) from the given points to our line is less than would be the case for any other straight line in the (y, t) plane.

The determination of the secular trend[1] in a time series may be based on this theorem, and our confidence in the results obtained is based upon the knowledge that the secular trend we determine is the best approximation we can hope for, where the word "best" is used in the sense of the method of least squares.

When a mathematical method of statistics is not based upon a theorem from pure mathematics, it is on the same plane as any empirical process. It should be subjected to experimental test in a controlled problem, where the results which should be obtained are known *a priori*. If a sensible problem can be proposed, where the results are known, in which the method in question leads to conclusions at variance with the truth, doubt should be cast upon all conclusions obtained by use of the method. Moreover, if two methods are available, of which one is founded logically and the other only empirically, with a slight doubt, perhaps, as to its general validity, it is obvious that the logically founded method is to be preferred. In the following discussion a logical background is given for the method of monthly means for determining seasonal variation. Afterwards an example of an admitted type is treated by Persons' method, and it is shown that the results obtained are widely at variance with the truth. The method of monthly means gives the correct result in this example.

2. THE METHOD OF MONTHLY MEANS

It is presumed that our data consist of a series of monthly entries of the values of some quantity over a series of k consecutive years. It will be supposed that any secular change originally present in the data has been eliminated, for example, by fitting a straight line to the original data by the method of least squares and by then subtracting the ordinates of this straight line from the corresponding entries in the original data. Let $f(t)$ represent the value of our entry t months from the zero date. For simplicity of nomenclature $t=0$ will be spoken of as January of the first year, $t=1$ as February of the first year, $t=12$ as January of the second year, $t=26$ as March of the third year, etc.

[1] Persons, *loc. cit.*, p. 12.

The method of monthly means for the determination of the seasonal variation in $f(t)$ is described in the following paragraph:

Form a new January entry by taking the arithmetic mean of all the January entries over the k given years; form a February entry by taking the arithmetic mean of all February entries; . . . form a December entry similarly from the December entries over the k years. This series of twelve monthly means is then to be taken as our best approximation to the values which $f(t)$ *would have had* in *all* years at the corresponding months if no causes had been influencing the values except those which lead to seasonal variation.

A seasonal variation is defined as a periodic change with the period one year. The graph of a seasonal variation over a period of one year is *not necessarily a single graceful wave* with a well-defined crest and trough. The essential feature of a strictly seasonal variation is that its numerical value is the same, at corresponding months, in all years. A seasonal variation thus yields the same values for the Januarys of all years, and similar constant results for the other months. Hence, it is obvious that the following theorem is true:

Theorem (1). *If $f(t)$ actually is a periodic function whose period is one year, the monthly entries obtained by our method are exactly the values of $f(t)$ at the corresponding months.*

The second theorem we shall state is designed to show explicitly the exact power of the method. Let $P(t)$ represent the periodic function, with the period one year, whose values for all Januarys, Februarys, etc., are the corresponding monthly means obtained above. Thus, $P(0)=P(12)=P(24)$, etc., = the January mean; $P(3)=P(15)=P(27)$, etc., = the April mean, etc.

Theorem (2). *Let $f(t)$ be any function of the time t known from $t=0$ to $t=12k$, that is, over a period of k years. Then, the sum of the squares of the residuals $[f(t)-P(t)]$, for all values of t, or*

(1) $[f(0)-P(0)]^2+[f(1)-P(1)]^2+ \ . \ . \ . \ +[f(12k-1)-P(12k-1)]^2$ *is smaller in value than it would be if any other periodic function with period one year were used in place of $P(t)$.*

It is seen that Theorem (2) shows $P(t)$ to be the answer to the following problem:

(2) *To determine a periodic function $P(t)$ which, in the sense of the method of least squares, is the best approximation to $f(t)$.*

The comparison of (2) with the theorem of the introduction shows the analogy between the method of monthly means and the method by which we determine a secular trend. The proof of Theorem (2) is extremely simple. It is well known that the sum of the squares of the deviations of a group of quantities from their arithmetic mean is less

than the sum of the squares of the deviations of the quantities from any number other than the arithmetic mean. The sum (1) consists of $12k$ terms which can be thought of as the sum of 12 groups of k terms each, one group corresponding to each month of the year. The January group, for example, is k times the sum of the squares of the deviations of the January entries about their arithmetic mean, which is $P(0)$. Hence, the January group in (1) is smaller in value than it would be if any other number were substituted in place of $P(0)$. Similar reasoning applies to the other eleven monthly groups in (1). Hence, the sum (1) is smaller in value than it would be if any other periodic function, with the period one year, were used in place of $P(t)$.

TABLE I

Val. of t	Val. of $f(t)$	Val. of t	Val. of $f(t)$	Val. of t	Val. of $f(t)$	Val. of t	Val. of $f(t)$
0	0.0	30	−7.1	60	0.0	90	0.0
1	2.3	31	−9.0	61	2.1	91	−2.1
2	4.3	32	−10.4	62	4.0	92	−4.0
3	5.8	33	−11.2	63	5.4	93	−5.4
4	6.7	34	−11.4	64	6.2	94	−6.2
5	7.1	35	−10.9	65	6.5	95	−6.5
6	7.1	36	−10.0	66	6.5	96	−6.5
7	7.0	37	−8.9	67	6.4	97	−6.4
8	6.9	38	−7.9	68	6.4	98	−6.4
9	7.2	39	−7.2	69	6.9	99	−6.9
10	7.9	40	−6.9	70	7.8	100	−7.8
11	8.9	41	−7.0	71	9.0	101	−9.0
12	10.0	42	−7.1	72	10.5	102	−10.5
13	10.9	43	−7.1	73	11.8	103	−11.8
14	11.4	44	−6.7	74	12.7	104	−12.7
15	11.2	45	−5.8	75	13.0	105	−13.0
16	10.4	46	−4.3	76	12.7	106	−12.7
17	9.0	47	−2.3	77	11.8	107	−11.8
18	7.1	48	0.0	78	10.5	108	−10.5
19	5.1	49	1.0	79	9.0	109	−9.0
20	3.3	50	1.7	80	7.8	110	−7.8
21	1.8	51	2.0	81	6.9	111	−6.9
22	0.9	52	1.7	82	6.4	112	−6.4
23	0.3	53	1.0	83	6.4	113	−6.4
24	0.0	54	0.0	84	6.5	114	−6.5
25	−0.3	55	−1.0	85	6.5	115	−6.5
26	−0.8	56	−1.7	86	6.2	116	−6.2
27	−1.8	57	−2.0	87	5.4	117	−5.4
28	−3.3	58	−1.7	88	4.0	118	−4.0
29	−5.1	59	−1.0	89	2.1	119	−2.1

Let us apply the method of monthly means to an example arranged so as to forestall a certain objection which might be raised against the process. Let the values of our data $f(t)$ be as given in Table I, where $k=10$. The data have already been corrected for secular trend. The monthly means are found to be:

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.0	1.0	1.7	2.0	1.7	1.0	0.0	−1.0	−1.7	−2.0	−1.7	−1.0

In this case the function $P(t)$ which we determine as representing the seasonal variation has the monthly values listed in the table. The standard deviation of the residual function $f(t)-P(t)$ is found to be approximately 7. At first thought, one might consider this large value as an indication that our periodic function $P(t)$ was a poor approximation to the true seasonal variation. As a matter of fact, our function $P(t)$ in this case is *exactly equal* to the true seasonal variation, for $f(t)$ was computed from the following formulas:

$$f(t)=2\sin\left(\frac{t}{12}.360^\circ\right)+10\sin\left(\frac{t}{48}.360^\circ\right), \quad \textit{from } t=0 \textit{ to } t=48,$$

$$f(t)=2\sin(t.30^\circ), \quad \textit{from } t=48 \textit{ to } t=60,$$

$$f(t)=2\sin(t.30^\circ)+11\sin\left(\frac{t}{60}.360^\circ\right), \quad \textit{from } t=60 \textit{ to } t=120.$$

In other words, the $f(t)$ we are working with is the result of superimposing a varying long term oscillation on the seasonal variation given by $2\sin(t.30^\circ)$. Evidently, this problem shows that the size of the standard deviation of $f(t)-P(t)$ cannot be taken as a criterion of the applicability of the method.

The question naturally arises as to what is a proper criterion of applicability. The following theorem furnishes us with a theoretical answer:

Theorem (3). *The method of monthly means gives us the actual monthly values of the seasonal variation in case $f(t)$ is made up of the following component parts:*

(A) *A seasonal variation, strictly periodic throughout the period of years under consideration.*

(B) *A long term variation which consists of certain independent pieces, each extending over a whole number of years, where each piece represents a whole number of complete oscillations of a corresponding periodic function whose period is an integral number (two or greater) of years.*

(C) *A second, a third, etc., long-term variation having the characteristics specified in* (B).

The language of (A) and (B) is geometrical in nature, each component of $f(t)$ being thought of as a curve in the (y, t) plane. It is desired that a certain implicit agreement be understood in the statement of Theorem (3). As a consequence of the theory of Fourier series, it is known that a periodic function with the period 5 years, for example, may have component parts with the respective periods $\frac{1}{2}$ of 5 years, $\frac{1}{3}$ of 5 years, $\frac{1}{4}$ of 5 years, $\frac{1}{5}$ of 5 years, or 1 year, $\frac{1}{6}$ of 5 years, etc. The agreement in our case is that the periodic functions referred to in (B) *have no component parts of period one year.* If the long-term varia-

tions originally had any one-year components, we are assuming that these were the same for all the variations and that this constant one-year oscillation was then thrown in under the variation mentioned in (A).

An example in which the conditions of Theorem (3) are satisfied would be given, for instance, by a function $f(t)$ defined for 17 years, consisting of

1. A seasonal variation.
2. A long-term variation which
   (a) for the first four years consists of two complete cycles of a periodic function with period two years,
   (b) for the next three years consists of one cycle of a periodic function whose period is three years,
   (c) for the next ten years consists of two complete cycles of a periodic function whose period is five years.
3. A second long-term variation which
   (a) for the first five years consists of one cycle of a periodic function whose period is five years,
   (b) for the next twelve years consists of four cycles of a periodic function whose period is three years.

A certain fundamental property of sines and cosines[1] makes Theorem (3) obvious to one familiar with the theory of Fourier series. Consider the particular function $\cos(t\ .15°)$, which has two years as its period of oscillation. Let h be *any* positive integer and let A be less than $720°/h$. Then the property referred to is the fact that

$$(3)\quad \cos A+\cos(A+b)+\cos(A+2b)+\ \ .\ .\ .\ \ +\cos[A+(h-1)b]=0,$$

where $b=720°/h$. In the averaging process of the method of monthly means we meet consequences of this property which is possessed by all sines and cosines. In determining the mean for any one month, we form a sum of the values of $f(t)$, which, for February, would be

$$(4)\quad f(1)+f(1+12)+\ \ .\ .\ .\ \ +f[1+(k-1)12].$$

The effect of the long-term variations (B) and (C) on the sum in (4) is zero, because of equations like (3) which would hold for each piece of (B). The seasonal variation, however, furnishes to (4) exactly k times the value the variation takes on at February in all years. Hence, the monthly mean of $f(t)$ for February is the exact value of the seasonal variation for this month. Similar reasoning applies in the case of the other monthly means, so that Theorem (3) is true.

The statements of Theorems (2) and (3) justify us in applying the method of monthly means in the analysis of data which are affected

[1] Bôcher, *Annals of Mathematics*, Second Series, Vol. 7 (1906), p. 135, Formula (63).

by the business cycle. In such cases, it is true, the assumptions of Theorem (3) are not exactly satisfied. Nevertheless, there is enough similarity between the conditions of Theorem (3) and the actual conditions affecting the economic data to give us confidence in the results obtained by taking monthly means. Moreover, we always have the unquestionable truth of Theorem (2) as a foundation for our belief. The ultimate test of any method in statistics is, of course, the degree of success it attains in actual practice. This test has not as yet been applied to any great extent in the case of the present method, but it is hoped that its simplicity and ease of application will permit such tests in the future. One application to a set of data is treated in the next part of this paper in connection with a comparison of the method used by Persons and that of monthly means.

3. COMPARISON OF THE METHOD OF MONTHLY MEANS WITH THAT OF PROFESSOR PERSONS

Consider the data given in Table II. This set of values was computed by means of the following formulas:

$$f(t) = 15 + \sin t(30°) + 4 \sin t(10°), \quad \textit{from } t = 0 \textit{ to } t = 36,$$
$$f(t) = 15 + \sin t(30°) + 6 \sin t(10°), \quad \textit{from } t = 36 \textit{ to } t = 72,$$
$$f(t) = 15 + \sin t(30°) + 2 \sin t(10°), \quad \textit{from } t = 72 \textit{ to } t = 108.$$

We have in this case data over 9 years which are the result of compounding the seasonal variation $15+\sin t(30°)$ with the long-term variations given, respectively, by the expressions $4 \sin t(10°)$, $6 \sin t(10°)$, and $2 \sin t(10°)$. The conditions of Theorem (3) of the previous section are satisfied, and, therefore, the method of monthly means leads us to the exact values of the seasonal variation, which are given in the following table:

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
15.00	15.50	15.87	16.00	15.87	15.50	15.00	14.50	14.13	14.00	14.13	14.50

Let us consider obtaining the values of the seasonal variation by Persons' method. First, we are required to compute the ratios of each entry in the $f(t)$ table to the preceding entry. The results of this computation are arranged in monthly columns in Table III. Then, in the resulting series of relatives for each of the twelve months, we pick out the median values, which are listed in Table IV. In using the method under consideration, the assumption now is made that the seasonal variation causes, in the average, each February

value to be 1.018 (Table IV) times the preceding January value, each March value to be 1.016 times the preceding February value, etc. It is not our present purpose to consider the non-mathematical arguments in justification of this assumption. However, it must be admitted that the assumption appears to be sensible and would be very acceptable if no logically-founded method were available and if the results to be found below were not on hand as contrary evidence. Instead of considering an argument, let us compare the results of this method with the actual values of the seasonal variation which should be obtained in the present instance.

TABLE II

TABULATION OF $f(t)$ BY MONTHS

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1st	15.000	16.196	17.234	18.000	18.438	18.564	18.464	18.260	18.074	18.000	18.074	18.260
2d	18.464	18.564	18.438	18.000	17.234	16.196	15.000	13.804	12.766	12.000	11.562	11.436
3d	11.536	11.740	11.926	12.000	11.926	11.740	11.536	11.436	11.562	12.000	12.766	13.804
4th	15.000	16.544	17.918	19.000	19.724	20.096	20.196	20.140	20.044	20.000	20.044	20.140
5th	20.196	20.096	19.724	19.000	17.918	16.544	15.000	13.456	12.082	11.000	10.276	9.904
6th	9.804	9.860	9.956	10.000	9.956	9.860	9.804	9.904	10.276	11.000	12.082	13.456
7th	15.000	15.848	16.550	17.000	17.152	17.032	16.732	16.380	16.104	16.000	16.104	16.380
8th	16.732	17.032	17.152	17.000	16.550	15.848	15.000	14.152	13.450	13.000	12.848	12.968
9th	13.268	13.620	13.896	14.000	13.896	13.620	13.268	12.968	12.848	13.000	13.450	14.152

TABLE III

TABULATION OF RELATIVES BY MONTHS

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1st	1.060[1]	1.800	1.064	1.045	1.024	1.006	.995	.989	.990	.996	1.004	1.010
2d	1.011	1.005	.994	.976	.957	.940	.926	.920	.925	.940	.963	.990
3d	1.009	1.017	1.016	1.006	.994	.984	.983	.991	1.010	1.038	1.064	1.081
4th	1.087	1.103	1.083	1.060	1.038	1.019	1.005	.997	.995	.998	1.002	1.005
5th	1.003	.995	.981	.963	.943	.923	.907	.897	.897	.910	.935	.963
6th	.990	1.006	1.010	1.004	.996	.990	.994	1.010	1.038	1.070	1.098	1.114
7th	1.114	1.057	1.044	1.027	1.009	.993	.982	.979	.983	.994	1.006	1.017
8th	1.021	1.018	1.007	.991	.974	.958	.946	.943	.951	.966	.989	1.009
9th	1.023	1.026	1.021	1.007	.993	.980	.974	.977	.991	1.011	1.035	1.052

[1] January, 10th year.

From the monthly medians of the link relatives listed in Table IV we obtain[1] a corresponding series of relatives on January as a base. For example, the March entry is found by computing (1.018) (1.016) = 1.034, the April value is (1.006) (1.034) = 1.040, etc., as given in Table IV. By this method we obtain for January itself the value (1.021) (.978) = .999, instead of 1.000. This discrepancy[1] is spread over the whole year, giving the final adjusted values found in Table IV. For purposes of comparison the true values of the monthly relatives of the seasonal variation have been computed on January as a base and are listed in Table IV.

[1] Persons, *loc. cit.*, p. 31.

To find actual numerical values of the seasonal variation from the final adjusted relatives obtained by Persons' method, we compute the mean of all the entries in the original Table II, which is found to be 15. Then we multiply in succession by the monthly relatives. The results of this computation are given in Table IV, with the true values of the seasonal variation listed simultaneously for purposes of comparison. The true monthly increments, or decrements, of the seasonal variation and those of the computed variation are likewise given in Table IV.

TABLE IV

Month	Medians of relatives	Medians on January as base	Medians adjusted	Actual monthly relatives on January as base	Persons' seasonal variation	Actual seasonal variation	Persons' monthly increment	Actual monthly increment
January	1.021	.999	1.000	1.000	15.00	15.00	.31	.50
February	1.018	1.018	1.018	1.033	15.27	15.50	.27	.50
March	1.016	1.034	1.034	1.058	15.52	15.87	.25	.37
April	1.006	1.040	1.041	1.067	15.61	16.00	.09	.13
May	.994	1.034	1.035	1.058	15.52	15.87	−.09	−.13
June	.984	1.018	1.018	1.033	15.27	15.50	−.25	−.37
July	.982	.999	1.000	1.000	15.00	15.00	−.27	−.50
August	.979	.978	.979	.967	14.69	14.59	−.31	−.50
September	.990	.969	.969	.942	14.54	14.13	−.15	−.37
October	.996	.965	.966	.933	14.48	14.00	−.06	−.13
November	1.004	.969	.970	.942	14.53	14.13	.05	.13
December	1.010	.978	.979	.967	14.69	14.50	.16	.37

The conclusions to be drawn from the above problem are obvious. By Persons' method we are led through the computation of 108 relatives, the determination of twelve medians, the reduction of these medians to January as a base, the adjustment of these final values to distribute a certain discrepancy over the whole year, and then to the transfer from these adjusted values to actual numerical values of the seasonal variation. Finally, we discover that the error in the monthly decrements or increments is generally about 50 per cent. On the other hand, the method of monthly means leads to the correct numerical values of the seasonal variation after the easy computation of twelve monthly means.

The actual statistical series in which we search for a seasonal variation may differ from the simple case we have treated above, but they differ in that they are much more complicated. If Persons' method does not yield the correct results in a simple case, we must logically consider that its applicability in a complicated instance is open to question.

SOME RESULTS OF THE 1920 POPULATION CENSUS[1]

By Joseph A. Hill

The first of the results to be arrived at and announced in the process of tabulating and publishing the census data is the total population. The count of population begins as soon as the first schedules have been received, being a hand-count of names; and thus the total population is one result, and the only important one, arrived at without the use of electrical tabulating machinery.

The taking of the Fourteenth Census began on January 2, 1920, on which cold morning 90,000 enumerators started out from their homes with portfolios of schedules under their arms and fountain pens in their pockets, being thus armed and equipped and having been duly instructed to take the census of the United States.

The bulk of the schedules had been received in Washington by the end of March, and most of the remainder by the end of April; but schedules continued to come in all through the summer months, and the hand-count of names was not completed until October 7, 1920, on which date the more or less interested world learned that the population of the United States, not including outlying possessions, was a little over 105,000,000. The final figure, as announced later, was 105,710,620. Population since the preceding census had increased 14.9 per cent. This is the lowest rate of decennial increase recorded in the history of the nation and represents a marked retardation of growth as compared even with the preceding decade, when the increase was 21 per cent. Although this is not the kind of record in which the American people usually take pride, I doubt whether there is any good reason to regret, and whether anybody did in fact regret, this retardation in our rate of growth. It may be of interest to consider where we should be now if our rate of growth had never been retarded.

During the first seven decades of our history as a nation, population increased with remarkable uniformity at a rate deviating but little from 35 per cent, the actual rates for the successive decades being as follows: 35.1, 36.4, 33.1, 33.5, 32.7, 35.9, 35.6. This brings us down to 1860, just before the Civil War. If the country had kept on growing at the rate of 35 per cent per decade we should have had in 1920 a population of 190,000,000. That numerically is about where we should

[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

be now if our rate of growth had never been retarded. By the end of the present century, if the same rate of growth were to continue, we should be past the two billion mark. I have not carried this computation any farther, but no less an authority than Darwin, whose mathematics I judge it unnecessary to verify, writing in the decade following the census of 1860, pointed out that the population of the United States, if it kept on doubling every twenty-five years as it was then doing, would in 657 years cover "the whole terraqueous globe so thickly that four men would have to stand on each square yard of surface." That brings us to about the year 2500, and it is hardly worth while to go any farther—we may stop with four to a square yard.

Darwin, needless to say, was not predicting. He introduced this statement in his *Descent of Man* simply as indicating that a rate of growth such as that in the United States, the highest rate probably ever experienced for as long a period by any considerable population in the history of mankind, was necessarily bound to be checked in some way sooner or later. And in fact the first check came at the period in which he was writing; for the next census, that of 1870, recorded a marked reduction in the rate of growth. The decennial rate of increase dropped to 26.6 per cent, and it stayed there approximately for the next two decades, being 26 from 1870 to 1880, and 25.5 from 1880 to 1890. These rates, it should be noted, are based on corrected figures for the 1870 census. It was in reference to this period that Francis A. Walker promulgated his theory of a check to natural increase of native population being caused by the great influx of foreigners, this accession of foreigners constituting, as he phrased it, "a shock to the principle of population on the part of the native population." With 1890 the period of 26 per cent increase came to an end. There was another retardation of growth. The percentage fell to 20.7 between 1890 and 1900, followed by a rate of 21 between 1900 and 1910.

Noting that the United States has passed through a period of 35 per cent increase lasting 70 years, followed by a period of 26 per cent increase lasting 30 years and then by a period of 21 per cent increase lasting 20 years, one wonders whether the decade which has just been completed and which shows an increase of 14.9 per cent inaugurates a 15 per cent period. I should not be surprised if it did. At any rate, considering the evident intention of Congress to restrict immigration or possibly to stop it altogether—an intention which, I think, public sentiment supports—and considering also the tendency toward smaller families and a lower birth rate on the part of the native population,

I will chance the prediction that we are not very soon coming back to the 21 per cent increase of the preceding period.

It is not difficult to account for the check to population growth in the decade just completed. If the population of the United States between 1910 and 1920 had increased at the same rate that it did between 1900 and 1910, that is, if there had been no retardation of growth in the later decade as compared with the earlier, we should have had in 1920 a population of about 111,300,000 instead of 105,700,000. Therefore we are, so to speak, short about six million. This shortage was due largely to the check to immigration consequent upon the outbreak of the European War. Between 1900 and 1910 over 8,000,000 immigrants arrived in the United States. Between 1910 and 1920 the number was about 5,000,000, which was hardly more than sufficient to make good the losses from emigration and from deaths among immigrants.

Consequently the percentage of increase for the foreign-born white fell off from 30.7 between 1900 to 1910 to 2.8 between 1910 and 1920. If this element of our population had maintained the same rate of growth in the later decade that it had in the earlier, it would have increased by over 4,000,000, while in fact it increased only 367,000. That difference largely accounts for the retardation of our population growth. But it may be noted that the percentage of increase fell off likewise, though not to anything like the same degree, in the case of each of the two other main components of the population, namely, the native white and the negro. In case of the former, the native white, the percentage of increase declined from 20.8 between 1900 and 1910 to 18.6 between 1910 and 1920, and in the case of the negro from 11.2 in the earlier decade to 6.5 in the later. A decline in the percentage of increase for the native white was to be anticipated if for no other reason than because the growth of the native white is promoted by the birth of native children in immigrant families, and of course this source of increase begins to dry up as soon as immigration stops or is checked. But the growth of negro population is not affected to any appreciable degree by immigration, either directly or indirectly, and the check to its growth, which is one of the surprising results of the census, can mean only one thing—a falling-off in natural increase, indicating either a decreasing birth rate or an increasing death rate, or both.

Turning now to another subject, the growth of urban population, we may note that the Fourteenth Census records the fact that the percentage urban in our population has now crossed the halfway mark—halfway, that is, between no urban and all urban—the exact percentage

urban in 1920 being 51.4 as compared with 45.8 in 1910. Therefore, a majority of the people in the United States are now city residents according to the official census definition of the term "city," which signifies any incorporated community having a population of 2,500 or more.

Going back only forty years to 1880, we find that the percentage of city dwellers at that time was 28.6, a percentage which increased to 35.4 in 1890, to 40 in 1900, to 45.8 in 1910, and, as just stated, to 51.4 in 1920, thus advancing about 5 points during each of the last three decades, so that the increase from 1910 to 1920 on the face of it does seem exceptional. This statement, however, requires, I think, some qualification. There is, I believe, a difference between the last and the preceding decades; for, looking upon the increase in the percentage urban as being, mathematically speaking, a function of population growth—as bearing, that is, a relation to population growth such that it tends to vary directly as the rate of total population growth varies, mounting more rapidly when population is increasing rapidly and more slowly when it is increasing slowly—we may note as significant the fact that an increase of 14.9 per cent in the total population between 1910 and 1920 produced as great an advance in the percentage urban as was produced by an increase of 21 per cent in the total population growth between 1900 and 1910 and 20.7 per cent between 1890 and 1900. Thus the slowing up of population growth between 1910 and 1920 did not retard the increase in the percentage urban, and considered in that relation the increase was exceptionally large.

The increase in the percentage urban implies, of course, that the urban population increased more rapidly than the rural. The contrast between the rates of growth for the two classes of population was in fact very pronounced. Between 1910 and 1920 the urban population increased from 42,166,120 to 54,304,603, an increase of 26.4 per cent, while the rural increased from 49,806,146 to 51,406,017, an increase of 3.2 per cent. Both rates of increase were smaller than in the preceding decade, when the urban population increased 38.8 per cent and the rural 9.2.

The rural population as defined by the census includes numerous small incorporated villages, boroughs, and towns having fewer than 2,500 inhabitants. The rural population outside these villages, which might be called truly rural, increased only about 2 per cent between 1910 and 1920, being 41,636,997 in 1910 and 42,436,776 in 1920, an absolute increase of about 800,000 as compared with an increase of 12,000,000 in the urban population.

The country village, if it grows, becomes some day a small city. It

crosses the 2,500 line and thus grows out of its class just as inevitably as the boy attains the stature of a man. Thus the urban population is constantly being recruited and the rural population depleted by these country villages which pass over the border line that separates town from country as defined by the census. In this way the urban population grows by accretion at the expense of the rural population as well as by expansion or natural increase and immigration. In this respect it may be said that the urban population has a sort of unfair advantage over the rural in the rivalry of growth. The latter is handicapped in the race. If it grows too ambitiously it grows away from itself.

Between 1910 and 1920, 471 rural villages or towns became small cities. Each of these as it crossed the line to the enemy's territory took with it 2,500 people, and thus altogether they added 1,177,500 to the urban population of the United States and took away that number from the rural. They also added to the urban population whatever growth they had after they crossed the line up to the time the 1920 census was taken. This growth of urban population by accretion being, however, only a little over 1,000,000, the growth by expansion resulting from natural increase and migration must have been nearly 11,000,000. For the purpose of a rough estimate or approximation, I believe we could take 10 per cent as representing the rate of natural increase in city population, and on that basis we may resolve the total increase of over 12,000,000 in urban population as follows: 1,175,000 growth by accretion; 4,500,000 natural increase within the city population, or excess of births over deaths; 6,500,000 migration from without. It may be remarked, moreover, that in view of the check to the foreign immigration to the United States the migration which contributed to the growth of cities in this last decade must have been largely domestic migration, that is, migration within the United States from country to city. This domestic cityward migration may be estimated as between 3,000,000 and 4,000,000.

An increase in the percentage urban—though sometimes deplored or even featured sensationally as an alarming condition—is, I believe, inevitable in a settled and growing country, although it may not of course be inevitable to the degree to which it actually takes place. But where the agricultural land has been practically all taken up, if population is still to increase that increase must almost inevitably be accompanied by, or result in, an increase in the percentage urban. It is a tendency which could be held in check or counteracted only by a resort to more intensive methods of agriculture or by the establishment of rural industries of such kind that they could thrive and still

remain rural, and not result in the creation of rural villages that immediately start to become small cities.

Any picture of growing rural communities on their way to become small cities needs, however, a counterpart, or else needs to be redrawn if it is to have the due proportion of light and shade required to portray actual conditions. For there are large areas in the United States in which population is decreasing, or, at any rate, in which population decreased during the last ten years, and these areas consist mainly of rural districts including many small incorporated places—villages, boroughs, or cities, so-called. On one of the census county maps the areas of decreasing population are distinguished by patches of white, the rest of the map being shaded. These white areas appear in every state with the exception of Connecticut and Arizona; and they would appear in Connecticut if the areas were defined by township instead of by county lines, and probably also in Arizona if the counties were not so large. On this map 78.2 per cent of the total area of Missouri is white, 77.9 per cent of the little state of Delaware, 73 per cent of Nevada, 68.4 per cent of Indiana, 61.2 per cent of New York state, and 60 per cent of Vermont.

Thus almost every state may be divided into two contrasted groups of counties, the one populous and increasing in population, the other thinly populated and decreasing. It is a case where the rich in population are growing richer and the poor poorer.

In Missouri, for instance, where the population as a whole increased 3.4 per cent between 1910 and 1920, there were 26 counties, containing the principal cities of the state, in which it increased in the aggregate 14.4 per cent, while in the rest of the state it decreased 7.1 per cent. As another illustration take New York state, where the increase of 14 per cent in the total population of the state was the net result of an increase of 17.7 per cent in the population of 28 counties and a decrease of 6.2 per cent in the population of 34 counties.

In the United States as a whole and in nearly every individual state the area of decreasing population is larger than it was 10 years ago. Among the states there are only two or three exceptions, of which Iowa is the most notable. In that state the area of decreasing population, which, as shown by the census of 1910, covered 70 per cent of the total area of the state, has now shrunk to only 26 per cent of the total. Thus Iowa has come back to a certain extent. In Wisconsin and Minnesota, also in Utah, there was a similar though less marked change. But in most states, as well as in the country as a whole, the area of decreasing population, while fluctuating in outline, advancing at one point and receding at another, has broadened in extent, embracing a

greater number of counties and a much larger territory than it did ten years ago. In the United States as a whole the number of counties showing a decreasing population increased from 769 in 1910 to 1,082 in 1920, and the area embraced within such counties increased from 472,462 square miles to 908,803, and from 15.9 per cent of the total area of the United States to 30.6 per cent.

Naturally the check to immigration, or rather its practical cessation after the outbreak of the European War, and the marked retardation in the natural increase of negro population have brought about a change in the composition of the population of the United States as regards race and nativity. The percentage foreign-born—or, strictly speaking, the percentage of foreign-born whites—declined from 14.5 in 1910 to 13.0 in 1920, and the percentage negro declined from 10.7 to 9.9, while the percentage native white increased, being 74.4 in 1910 and 76.7 in 1920. Thus the census of 1920 as compared with 1910 shows a smaller percentage of negroes and of immigrants in our total population and a larger percentage of native whites. It might be said, therefore, that as regards the foreign-born element in our population the census indicates that the problem of assimilation has become slightly less formidable, although I am not so sure that it can be said that reduction in the percentage of negroes has made the race problem any less acute.

The percentages given above are very commonly cited and accepted as indicating the relative strength and importance of the foreign-born element. As a matter of fact, however, they are inadequate for that purpose, or possibly misleading, owing to the fact that the foreign-born population consists mostly of adults. There are comparatively few children among the arriving immigrants. Many children may be born to them after they come here, but these the census properly classifies as natives, the distinction between native and foreign being a line of statistical cleavage which cuts in between parents and children within the same family.

We obtain a more significant measure of the relative importance of the immigrants if we consider the percentage which they form of the adult population or, taking a figure which is conveniently accessible in the census reports, the percentage which they form of the total male population 21 years of age and over. It is a percentage which would be startling if we had not become familiar with it, or if it were announced for the first time in the history of census-taking. In 1910—to take first the earlier and more sensational percentage—24.6 per cent, or practically one fourth of the male population 21 years of age and over, consisted of immigrants. The percentage has now declined to 22.1, which is still over one fifth of the total. Of course, much higher

percentages are reported in certain sections of the country. In the Middle Atlantic States (New York, New Jersey, and Pennsylvania) 35.4 per cent of the male population 21 years of age and over is foreign-born: in the New England States, 38.2 per cent; in Massachusetts and in Boston, 46 per cent; and in New York City, 53.4 per cent.

I shall advert only briefly to the change in the age composition of the population as revealed by the census. Measured by percentages such changes seem slight, but yet they may be very significant. The proportion of children under 5 years of age in the total population has decreased from 11.6 per cent in 1910 to 10.9 in 1920; the proportion of older children from 5 to 14 increased very slightly, or from 20.5 per cent in 1910 to 20.9 per cent in 1920; but the proportion of the population between 15 and 35, comprising the period of youth and the most active and vigorous years of adult life, or of early manhood and womanhood, decreased from 36.2 per cent of the total population in 1910 to 33.9 per cent in 1920. For every age period above 35 the percentage has increased. The percentage between 35 and 45 increased from 12.7 to 13.4; between 45 and 65, from 14.6 to 16.1; 65 and over, from 4.3 to 4.7. In the aggregate the percentage of the population 35 years of age and over increased from 27 to 34.4, while the percentage below that age correspondingly fell off from 73 to 65.6.

The age composition of the population is affected by changes in the birth rate, in immigration, and in the death rate for the different age periods; and it is not easy to determine to what extent these various diverse factors have been operative in producing the change of age composition which has actually taken place. A decrease in the proportion of the population in the ages 15 to 35 is a natural result of the check to immigration, as most of the immigrants are within those ages when they arrive in this country. But the influenza epidemic may have played some part in producing this change, since that disease was, I believe, more prevalent and fatal in the period of life between 15 and 35 than in older or younger years. The decrease in the proportion of children probably reflects a decline in the birth rate; but the effects of a declining birth rate upon the proportion of children may be partially disguised or offset by a diminishing infant-mortality rate. A decrease in the proportion of children and adults under the age of 35 involves, of course, of itself an increase in the proportion above 35. At the same time a diminishing death rate in the period of middle age may have been operative as an independent cause resulting in the prolongation of life to older years.

In the negro population the percentage of children under 5 years of age decreased from 12.9 in 1910 to 10.9 in 1920, and the percentage

under 10 years of age from 25.6 to 23. Such a change as this indicates a decided decline in the birth rate. In the native white population of native parentage, the percentage of children under 5 declined from 13.2 to 12.6, and the percentage of children under 10 years of age from 25 to 24.5.

In the main the change in the age composition revealed by the census of 1920 as compared with that of 1910 is simply a continuation of a change that has been going on for a long time. Going back only to 1880 we find that 38.1 per cent of the population at that time consisted of children under 15 years of age; now the percentage is 31.7. The percentage above 45 increased during that interval from 16 to 20.8; and the percentage of old people above the age of 65 increased from 3.4 to 4.7. The population in this sense is growing older. Increased longevity would tend to produce this result, and so too would a diminishing birth rate. Probably both causes are operative.

To conclude with a recapitulation: A retardation of population growth; an increase in the percentage urban, more striking, all things considered, than in the preceding decade, and resulting to a greater extent from cityward migration; a marked extension of the area of decreasing population; a decrease in the percentage foreign-born caused by the check to foreign immigration, and in the percentage negro, indicating a declining birth rate for that race; a decrease in the proportion of children and of adults under 35 in the total population and a corresponding increase in the proportion above 35—these are some of the results shown by the Fourteenth Census.

KINETIC STATISTICS AS AN AID TO PRODUCTION AND DISTRIBUTION

By Walter N. Polakov

Manufacturing concerns, particularly those of considerable size, have for years been in the habit of maintaining statistical departments. It has been generally assumed that statistics of manufacturing activities, compiled by gathering and classifying data, are of assistance to executives in shaping policies or detecting major shortcomings. But it was not until the development of kinetic statistics that the executive found an effective aid for getting things done.

The function of these old statistical interpretations was:

1. To establish relations, existing in the *past*, among numerous factors which have influenced production.
2. To prognosticate *future* probabilities as to volume of business, prices and costs, and the general trend of other influential factors.

The basis for such work was usually found in:

1. Diverse manufacturing and accounting records of the concern itself.
2. Such other outside data as was available and pertinent to the subject studied.

The usefulness of these efforts is commonly limited by the very nature of the undertaking, because:

1. What *has been* in the past is not necessarily an indication of what *will be* in the future under changed conditions; indeed, if it were so, there would be no improvement, no progress, no growth.
2. What has been or what is being done in no way carries the assurance that things are as they *should be;* indeed, so long as there is no gage of perfection, no evaluation of past and present performance can be made, and such an absence of preëstablished aim renders the whole activity a purely accidental character.

These two intrinsic limitations of the traditional *static* statistical method give it a passive character which neither leads nor judges but merely records. Even the very progress thus recorded in rows of figures or curves reflects the chance development and a fatalistic attitude rather than an activity directed by volition toward a definite goal. Specific though limited usefulness of this static method is of course not denied; but its intrinsic limitations are emphasized in con-

tradistinction with the newer method of kinetic statistics, which involves a study of the movement through time toward a set task.

In order to comply with two fundamental characteristics of human nature, namely, the lure of perfection and the relativity of cause and effect in time, any statistical method dealing with any human activity should recognize that (1) the facts in themselves or in relation to each other are of no human interest except when *compared with the desired results*, and (2) the attainment of the desired results is of no human value unless it is *attained within time specified*. To be more explicit: Consumption of 30,000 heat units per kilowatt hour energy produced may mean 95 per cent perfection in one plant and 50 per cent waste in another; to build a house for $10,000 may be economical for the specification, but if it takes ten years to complete the construction, double the expense in six months would be more economical.

In practice, kinetic statistics are based on one constant scale of time, and the actual accomplishment is invariably compared with a predetermined task to be completed within the given period of time.

The practical task of controlling production must of necessity begin with measurement and, to be correct, measurements must be made in the proper dimension. It would be a grave blunder to apply a unit of one dimension to an entirely different dimension, or to use a measurement which contains a variable element. We cannot use for measuring human work the units of mechanical power such as foot-pounds or horse-power which embrace only the muscular work of men, even though these expressions contain the time rate, for it would be a confusion of part with the whole. The time rate of man's work is the only measure of production which is of the same dimensionality as the energy causing it, and it is as constant as the solar system itself.

Since time may be spent for different purposes and the amounts of work that can be done in a unit of time may of necessity differ, the scales may be as varied as are human activities themselves; but we cannot conceive human activity without or beyond time.

Time in its relation to our existence is divided into present, past, and future. Hence we have three fundamental managerial problems visualized in three forms of charts: as applied to the present or to current work—Man Record Charts; as referring to work done in the past—Machine Record Charts; and, finally, as projected to future work —Progress Charts, with their schedules laid out on the time scale of future requirements.

During the time devoted to productive work there is a variable amount of work done, as is shown on the Man Record Chart, but this work is performed and directed by men. "To feel the lure of perfec-

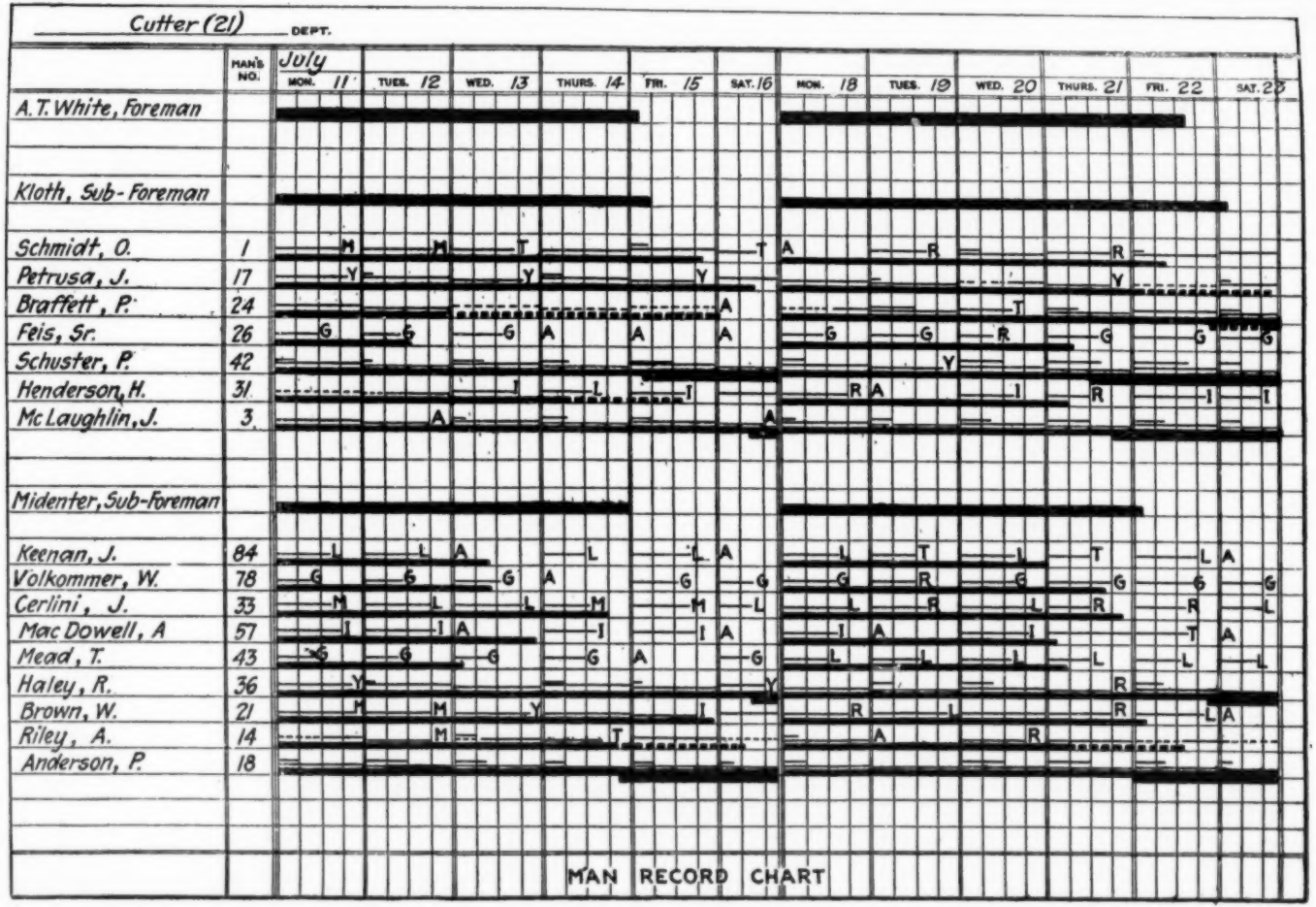


FIGURE 1.—MAN RECORD CHART

Width of daily space represents amount of work that should have been done in a day. Dash lines represent time taken to do work for which there was no time estimate. Solid thin lines represent the proportion of work done in a day, and heavy lines are the summaries. Letter symbols indicate the causes of delay or handicaps: A = absent; G = green operator; I = instructions lacking; L = slow operator; M = material troubles; R = repairs needed; T = tool trouble; V = holiday Y = smaller lot than estimate is based on.

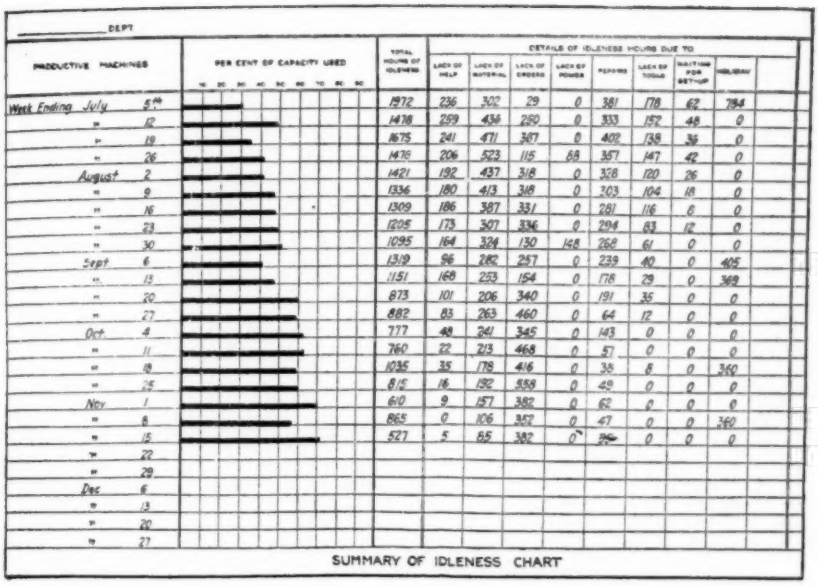
tion," says Professor C. J. Keyser, "in one or more types of excellence, however lowly, is to be human; not to feel it is to be sub-human." And a chart of this kind involves that ideal of service. It shows what is expected to be accomplished within the work time for any occupation, however lowly.

In such a chart this ever-striving impulse of self-expression in service, which throbs in every human being, is given adequate expression and stimulus. It is accomplished by predetermining the ideal, however modest, which is accepted by a man as within his power of attainment. Then, and only then, can the lines of attainment be drawn from day to day to denote the falling short of the aim or the equaling and even surpassing it, as the obstacles of inertia, ignorance, or lack of coördination are overcome by the strongest of all human propensities—the desire to excel oneself. This type of chart can truthfully be called a tool for humanizing industry, for it not only reveals to a man his own dignity and capacity as a creator, but subtly, though persistently, calls for coöperation between the workers with brain and brawn. It tells what each of us and all of us are doing at the present time.

The Machine Record Chart reveals to one who reads between the lines much more than merely the time a certain machine was idle. Its scale is also time, but the time during which a machine remains unproductive has a graver significance than a reminder that "time is money." It means that some one who should have operated it or supervised its operation was not employed, and the time consumed in inventing, developing, and building this machine, which is greater in its productive significance than the time of the operator, is irretrievably lost.

Likewise, the Material Utilization Chart (like that of fuel utilization developed by the author), indicating the waste of material or energy, has a deeper meaning. It shows the extent to which the work of other men in recovering, preparing, and delivering this material or energy has been destroyed. It means that the work of hosts of men has been rendered useless and that their productive time is forever lost. This type of chart gives us the measure of our utilization of the work that has been done before. It proves whether we are worthy of our inheritance from the past.

Lastly, the Progress Chart integrates all elements of work, it sums up the progress made, its acceleration, its retardation, its time rate. Like other charts it brings together the ideal and the fact. Its ideal projects into the future and sets before us the task which we are called upon to perform, no matter how small or how great it may be, whether filling an order in a shop, feeding a nation, or advancing the life and



DEPT

PRODUCTIVE MACHINES	PER CENT OF CAPACITY USED	TOTAL HOURS OF IDLENESS	DETAILS OF IDLENESS HOURS DUE TO							
			LACK OF HELP	LACK OF MATERIAL	LACK OF ORDERS	LACK OF POWER	REPAIRS	LACK OF TOOLS	WAITING FOR SET-UP	HOLIDAY
Week Ending July 5th		1972	236	302	29	0	381	178	62	784
" 12		1478	259	436	260	0	333	152	48	0
" 19		1675	241	471	367	0	402	138	36	0
" 26		1476	206	523	115	68	357	147	42	0
August 2		1421	192	437	318	0	328	120	26	0
" 9		1336	180	413	348	0	303	104	18	0
" 16		1309	186	387	331	0	281	116	8	0
" 23		1205	173	307	336	0	294	83	12	0
" 30		1095	164	324	130	148	268	61	0	0
Sept 6		1319	96	282	257	0	239	40	0	405
" 13		1151	168	253	154	0	178	29	0	369
" 20		873	101	206	340	0	191	35	0	0
" 27		882	83	263	460	0	64	12	0	0
Oct 4		777	48	241	345	0	143	0	0	0
" 11		760	22	213	468	0	57	0	0	0
" 18		1035	35	178	416	0	36	8	0	360
" 25		815	16	192	558	0	49	0	0	0
Nov 1		610	9	157	382	0	62	0	0	0
" 8		865	0	106	352	0	47	0	0	360
" 15		527	5	65	382	0	75	0	0	0
" 22										
" 29										
Dec 6										
" 13										
" 20										
" 27										

SUMMARY OF IDLENESS CHART

FIGURE 2.—MACHINE RECORD CHART: SUMMARY OF IDLENESS

This chart compares the records of twenty succeeding weeks and illustrates the progress made toward removing the causes of idleness due to knowledge of the causes of idleness. The numbers given in tabulation are man-hours lost due to various classified reasons. If an average hourly man rate is $1 and overhead $2, the 1,500 hours of weekly idleness cost the company $4,500 besides loss of profit on goods not produced. Incidentally, the purchasing power is also reduced by $1,500 direct loss of earnings, etc.

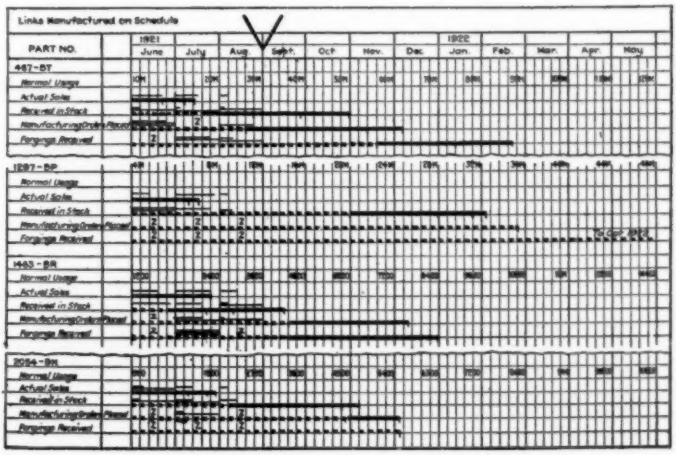


FIGURE 3.—PROGRESS CHART (continuous production)

The normal usage of 10,000 parts per month is compared with sales, production, orders placed, and parts received. Dash lines indicate the work done before June 1 when the chart was started. The chart is entered as of August 31. The figures at the left show amounts scheduled for the month; the figures at the right show the cumulative total to be done to date. All of these lines moved forward month by month, and the difference in the lengths of the cumulative lines always showed the parts in stock, the parts on order, and the parts on hand.

happiness of mankind. It calls for a plan and vision of the future. It is based on knowledge of the past, and it reveals our present position.

This time concept in the control of industry, direction of production, and measurement of human work thus stands revealed as the wished-for solution, free from error of confused types and dimensions. It refers all facts to the irreducible and final element of human life—time. But it is true to the human dimension, it is both human and humane; hence it obliterates conflicts between men and management, promotes the fullest exercise of man's creative forces, and places work in its proper relation to life.

An executive of a manufacturing concern which has used charts of this nature for several years recently told of his experience in these unequivocal words:

> I have frequently seen charts bring up an average accomplishment to a standard previously thought impossible and within a comparatively short time justify an intelligent raising of the standard without creating any friction. Charts viewed daily admit of an examination of the entire operation; absence of charts permits an observation of just that proportion of the operation which an executive can keep actual watch over. Without charts an executive is utterly helpless and at the mercy of those on whom he depends for his departmental work. On the other hand, a daily supervision of the charts, with proper action taken on the necessities for action thus disclosed, will automatically insure a proper operating statement. If charts are used the arrival of the operating statement need not be anticipated with alarm.[1]

Similarly, in representing and directing selling efforts, such kinetic charts, if properly introduced with carefully worked-out quotas for each salesman within a certain time, fully comply with the two fundamental requirements, namely, that the actual be compared with the ideal, and that it be measured in terms of time. The results are invariably most stimulating and gratifying.

Finally, activities of national magnitude lend themselves with equal readiness to an efficacious kinetic chart presentation. Predetermined national consumption (demand) of various commodities, when compared within the time specified with actual deliveries (for satisfaction of the demand) on such a chart, readily discloses any maladjustment of distribution, as, for instance, when most needed commodities such as ammonia were hardly brought in at all, and perishable goods (such as bananas) were imported in an appalling excess. Adjustment of such cases and prevention of their repetition are greatly facilitated by the disclosures clearly and immediately made by the use of this method of kinetic statistics.

There is but one more point that need be covered in this paper: The

[1] See Wallace Clark, "Gantt Chart," Ronald Press, N. Y., 1922. Charts reproduced by courtesy of the author.

aid rendered by the charts of kinetic statistics is (1) immediate, (2) universal, and (3) does not conflict with any other method, statistical or administrative.

It is immediate because the data are gathered by men actually engaged in production, and therefore any falling-short of standard spurs them on toward improvement or the elimination of handicaps. *Before*

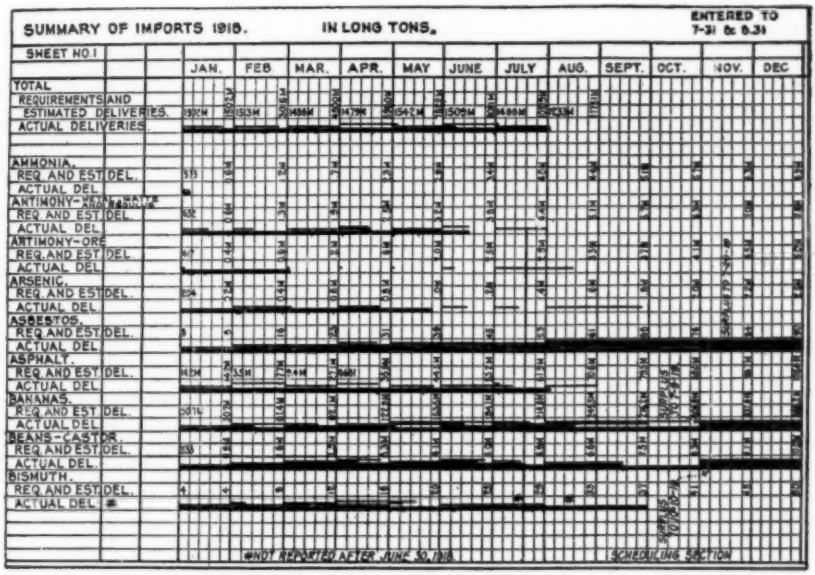

SUMMARY OF IMPORTS 1918. IN LONG TONS.
ENTERED TO 7-31 & 8-31
SHEET NO. 1
JAN. FEB MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC
TOTAL REQUIREMENTS AND ESTIMATED DELIVERIES.
ACTUAL DELIVERIES
AMMONIA. REQ. AND EST. DEL.
ACTUAL DEL.
ANTIMONY-ORE REQ. AND EST. DEL.
ACTUAL DEL.
ARSENIC. REQ. AND EST. DEL.
ACTUAL DEL.
ASBESTOS. REQ. AND EST. DEL.
ACTUAL DEL.
ASPHALT. REQ. AND EST. DEL.
ACTUAL DEL.
BANANAS. REQ. AND EST. DEL.
ACTUAL DEL.
BEANS-CASTOR. REQ. AND EST. DEL.
ACTUAL DEL.
BISMUTH. REQ. AND EST. DEL.
ACTUAL DEL.
NOT REPORTED AFTER JUNE 30 1918
SCHEDULING SECTION

FIGURE 4.—SUMMARY OF IMPORTS: COMPARISON OF REQUIREMENTS WITH ACTUAL DELIVERIES OF COMMODITIES

The thin lines represent actual monthly deliveries drawn to a scale of monthly requirements. The heavy lines indicate cumulative totals. The figures denote monthly (left) and cumulative (right) requirements. Plurality of lines indicate excess of deliveries over the requirements, the length of one month's space=100 per cent of estimated requirement.

the higher executives have an opportunity to criticize, they are asked to help.

It is universal since it is equally applicable to a small shop, to a great trust, a school, a railroad, or to a problem of national economy.

It does not conflict with any other form or manner of elaborating, combining, and presenting statistical data:—Kinetic charts have a mission quite their own—to tell while the thing is being done whether it is being done well, and if not, why not; and whether it will be done in time, and if not, what steps should be taken to get the thing done.

WESTERGAARD'S METHOD OF EXPECTED DEATHS AS APPLIED TO THE STUDY OF INFANT MORTALITY

By Robert M. Woodbury, *Children's Bureau*

A characteristic of infant mortality data, as well as of many other kinds of economic and social material, is that many and varied causes are at work to produce the given results. A prime requisite in a method for analyzing such data, therefore, is that it shall permit of separating out and determining the influence of each factor when other conditions or factors are held constant. This requisite is possessed by Professor Westergaard's method of expected deaths used in conjunction with multiple classification. The purpose of this paper is to present to American readers the mode of applying that method to infant mortality data, and incidentally to give certain partial results of applying it to data gathered by the United States Children's Bureau. It may be remarked in passing that the method may be applied as effectively to many other problems.

Among the causal factors with which we are concerned in analyzing infant mortality data the following may be included, at least tentatively: sex, age, single or plural birth, type of feeding, care of mother during pregnancy, mother's employment, care of infant during first year of life, economic status of the family, age of mother, order of birth, interval from the preceding birth, pregnancy of the mother following the the birth, nationality of the mother, death of the mother, housing conditions, and illegitimacy.

In relation to each factor three questions are always pertinent—the questions of relative mortality, of prevalence, and of the contribution which the factor makes to the general result. Thus, with respect to single and plural births, the first question is whether twins and triplets have a greater mortality than single births; the second, what proportion of the total births are plural; and the third, do twins and triplets contribute a large quota to the infant deaths? The answer to the last question obviously depends upon the answers to the other two. The first and third questions are often confused, as in the inquiry: Is the mother's employment an important factor in infant mortality? This is capable of two interpretations, one—of greater importance in an analysis of causes—relating to relative mortality, *i. e.*, whether infants whose mothers are employed are subject to a higher rate of mortality than infants whose mothers are not employed, and the other

relating to the amount of contribution to the total mortality, *i. e.*, whether any excess mortality among infants of employed mothers in connection with a large or small prevalence of mothers' employment results in an important contribution to infant mortality. This question is of secondary importance since the contribution is the resultant of two primary elements. The method of analysis should distinguish between these primary and secondary elements in the problem.

The conclusions reached with regard to the relative mortality associated with each factor, so far as the factor itself is conceived to represent a true causal element, are tentative; they are subject to qualification if intercorrelations with other factors are present. It is therefore important to study the intercorrelations of the several factors. These intercorrelations have two aspects: first, whether the presence of one factor is associated or correlated with the presence of another, and second, whether the relative mortality exhibited by the first factor varies as it is associated with the second. The amount of qualification of the tentative conclusion is dependent upon the closeness of correlation between the factors, the importance of the associated factors, and the degree of excess mortality connected with them. So far as no such intercorrelations are present, the tentative conclusion remains unmodified.

These principles may be apprehended more clearly in illustrations. An analysis of a group of births by sex shows (1) that males have a slight preponderance over females, and (2) that the mortality rate among males in the first year of life is slightly higher than that among females. To determine whether this tentative conclusion (2) requires qualification, the prevalence of male births must be studied in reference to other factors, types of feeding, single and plural births, age of mother, order of birth, earnings of father, employment of mother, etc.; if the proportion of male births does not vary with these other factors, the conclusion may be accepted as expressing the true excess mortality among male births.

On the other hand, an analysis of a group of births into single and plural births shows (1) that about 2 per cent of all births are twins or triplets, and (2) that the mortality among twins and triplets is between three and four times that among single births. The prevalence of twins and triplets is then studied with regard to other factors, age of mother, order of birth, type of feeding, earnings of father, employment of mother, etc. If the analysis indicates that twins and triplets are slightly more prevalent among births to older mothers and among births of later orders, and that they are more likely to be artificially fed, the tentative conclusion as to relative excess mortality among

twins and triplets over that among single births is subject to modification. The amount of modification arising from its correlation with artificial feeding, for example, will be greater the larger the proportion of twins and triplets artificially fed and the greater the excess mortality among artificially fed over that among breast-fed infants.[1] But with regard to each factor with which the proportion of twins and triplets is associated, the question arises whether the higher mortality among artificially fed, among the births to older mothers, and among the births of late orders is wholly or in part determined or influenced by the greater prevalence of twins and triplets.[2] The question, therefore, of the degree of modification of the tentative conclusions can be determined only after analysis.

The first recourse in analysis is usually to that universally applicable method, simple classification, or, as it may be termed when several factors are included, multiple classification. If births and deaths are classified each by the same factors, such as earnings of father or nationality of mother, the rates of mortality indicate whether the factors used in the classification can be considered as having an influence upon infant mortality. If two factors such as the two cited are correlated, the births and the deaths must be subclassified; the rates by earnings of father in each nationality group indicate whether earnings of father can be considered a factor independent of nationality, and the rates by nationality of mother in each earnings group indicate whether nationality of mother can be considered a factor independent of earnings. Evidently by this mode of comparison the effect of one factor upon the rate can be studied by the simple device of studying its influence in a group within which another factor does not vary. Multiple classification, if carried far enough, possesses the essential requirements for isolating the effect of a single factor.[3] But as more and more classifications are introduced, on the one hand the results become increasingly difficult for the mind to grasp, and on the other, the material becomes more and more subdivided until, finally, the base

[1] The degree of excess mortality of twins and triplets over that among single births may itself vary with the type of feeding.

[2] In this particular illustration the influence of the greater prevalence of twins and triplets among the artificially fed upon the relative mortality among artificially as compared with breast-fed infants is not great.

[3] In mathematical terms, assuming that all causal factors can be expressed numerically, the infant mortality rate, X_1, can be stated in terms of its several independent causal factors: $X_1 = f(X_2, X_3, X_4 \ldots X_n)$ where X_2, X_3, etc., are the independent causal factors. The partial derivative of X_1 with respect to any one factor, for example, $\frac{\delta X_1}{\delta X_2}$, measures the change in X_1 due to the change in X_2; in other words, measures the influence of X_2 upon X_1 when all other variables are considered constant. Geometrically, this partial derivative is the slope of X_1 measured along the axis of X_2. In a classification table, for example, Table V, values of X_1 are given for different values of X_2, with other factors, so far as they are included in the classification table, constant.

becomes too small to ensure valid conclusions. To meet the first of these difficulties, recourse may be had to the familiar process of selection of data. For example, the influence of varying prevalence of plural births may be eliminated by confining the analysis to single births, and the influence of differences in types of feeding may be eliminated by further omitting all except breast-fed infants. But to obviate the difficulty that the numbers in the final group may not be large enough to ensure valid results, recourse must be had to some method of summation.

To meet these difficulties in the use of the method of multiple classification recourse may be had to the method of expected deaths developed by Professor Harald Westergaard.[1] This method, in fact, offers a simple and easily applicable way of isolating the influence of a single factor from that of other associated factors, and of stating the results in clear and definite terms.

Because the wide applicability of the Westergaard method seems not to be generally appreciated in this country, it will be described briefly before returning to the subject of its application to a specific infant mortality problem. Though designated as the "method of expected deaths" on account of its first application to mortality data, it is not restricted in its application to these problems but can be applied to a great many other fields, and in these fields it might be termed the method of "expected cases," or, generally, "expected results." The essence of the method lies in so calculating the expected numbers that a comparison between them and the actual numbers will be free from the disturbing influence of one, two, or several factors. By this means the effect of a single cause is isolated from the influences of other causes.

The best known, as well as the earliest, applications of the method were to the problems of eliminating variations in age and sex composition in comparisons of mortality rates in urban and rural populations and of eliminating variations in age composition in comparisons of occupational mortality.[2] Since, in these applications, identical or

[1] *Die Lehre von der Mortalität und der Morbilität: Anthropologisch Statistiche Untersuchungen.* Jena. G. Fisher, 1882, pp. 28–30; and "Scope and Method of Statistics," this JOURNAL, Vol. XV, No. 115, Sept., 1916, pp. 260–64.

[2] The method of standardizing or correcting death rates for differences in age composition was clearly set forth in the introductory chapter of *Die Lehre von der Mortalität*, pp. 28–30. In England, in the Registrar-General's Report for 1882, this method of correcting for varying age composition in comparison of urban and rural districts was used. (Forty-fifth Annual Report of the Registrar-General of Births, Marriages, and Deaths in England, Abstracts of 1882, C–4009 London, 1884.) The use of corrected death rates for Hamburg by Koch in 1883 is mentioned by Von Mayr, *Statistik und Gesellschaftslehre*, Vol. II, p. 219. Westergaard himself mentions the use of the method of expected deaths by Ratcliffe, in a first report, *Observations on the Rate of Mortality and Sickness amongst Friendly Societies*, Manchester, 1850, quoted in *Die Lehre von der Mortalität*, p. 287. Ratcliffe, however, seems not to have appreciated its importance, for in a second report the method was apparently not used.

"standard" rates were applied to varying populations, or varying rates to identical or "standard" populations, the method is perhaps better known to English and American statisticians as the method of standards. But there is this difference: the name "method of standards," by suggesting that any standard is equally good, has sometimes led to the use of a standard that was not adapted to the particular problem; while the "method of expected cases," by comparing expected with actual numbers, always keeps as close as possible to the actual problem under consideration.[1]

With this preliminary statement, we may proceed to a study of the actual operation of the method in which its merits and its limitations will be revealed much more clearly than by mere description. The first question chosen to illustrate the operation of this method of expected deaths is that of determining the influence of order of birth upon infant mortality.[2] Order of birth is closely associated with age of mother, since a large proportion of the births of later orders are to the older mothers; it is also correlated to some extent with the prevalence of twins and triplets; and it is correlated slightly with low income, since larger families as measured by the number of births are more prevalent at the lower income levels.

TABLE I

AGE OF MOTHER AND ORDER OF BIRTH; LIVE BIRTHS IN EIGHT CITIES

Order of birth	Live births							
	Total	Age of mother						
		Under 20	20–24	25–29	30–34	35–39	40 and over	Not reported
Total	22,967	1,584	6,879	6,618	4,231	2,688	958	9
First	6,230	1,227	3,125	1,349	399	114	14	2
Second	4,954	311	2,196	1,621	599	204	22	1
Third	3,328	39	968	1,407	609	260	45	.
Fourth	2,481	5	412	1,043	694	268	57	2
Fifth	1,767	2	133	624	631	306	69	2
Sixth	1,263	....	32	339	480	326	85	1
Seventh	921	....	9	138	353	320	101	.
Eighth	677	....	3	68	226	289	91	.
Ninth	470	....	1	20	126	224	98	1
Tenth and later	876	....	....	9	114	377	376	.

Table I presents a distribution of live births classified by age of mother and order of birth.[3] An inspection of the distribution shows

[1] Compare the recent discussion of the best methods of choosing weights in the problem of measuring price increases—one of the familiar examples of the method of standards.

[2] For a similar application of the method to this problem see Westergaard, *op. cit.*, Revised ed., 1901, pp. 371–75.

[3] The material is for live births in selected years in eight cities studied by the Children's Bureau, and is taken from a report on infant mortality shortly to be issued.

at once that the lower orders of birth are associated with the younger ages and the higher orders with the higher ages. The infant mortality rates for the order of birth groups beginning with first births are 104.7, 95.7, 104.6, 108.8, 118.8, 122.7, 136.8, 135.9, 146.8, and for tenth and over, 181.5. It may be noted that the rate for first births is higher than that for second, and that there is a rapid increase in rate from 95.7 for second to 181.5 for births tenth and later in order. The average rate for births of all orders is 111.2; expressing this average as 100, the following numbers show the variation in rates by order: 94.2, 86.1, 94.1, 97.8, 106.8, 110.3, 123.0, 122.2, 132.0, 163.2. The rates for age-of-mother groups are: Under 20, 135.7; 20–24, 109.3; 25–29, 101.4; 30–34, 104.7; 35–39, 126.5; and 40 and over, 136.7.

In view of the fact that the infant mortality rates among births to older mothers are high and that these are largely births of the later orders, the question arises whether the age of mother is the factor that produces the high rate among the births of later orders, whether the order of birth is itself the causal element, or whether both factors contribute to the result.

This question can be answered by ascertaining what the rates by order of birth would have been on the assumption that age of mother is the sole causal factor, and comparing the actual with these calculated rates. Applying the average rates by age of mother to the distribution of births by order of birth and age of mother, the deaths in each sub-group can be calculated; the deaths in each order-of-birth group can then be added, and these totals compared with the actual deaths that occurred. If order of birth has no causal influence aside from its correlation with age of mother, the number of actual and of expected deaths will be equal. If, however, the actual deaths do not equal those

TABLE II

RELATIVE MORTALITY BY ORDER OF BIRTH, WHEN INFLUENCE OF AGE OF MOTHER IS ELIMINATED; LIVE BIRTHS IN EIGHT CITIES

Order of birth	Deaths			Ratio of original rate to average
	Actual	Expected	Ratio of actual to expected	
Total	2,555	2,555.3	100.0	100.0
First	652	704.1	92.7	94.2
Second	474	538.6	88.0	86.1
Third	348	356.8	97.6	94.1
Fourth	270	266.5	101.2	97.8
Fifth	210	192.7	109.0	106.8
Sixth	155	141.2	109.7	110.3
Seventh	126	106.2	118.4	123.0
Eighth	92	79.9	115.2	122.2
Ninth	69	57.3	120.2	132.0
Tenth and later	159	112.0	142.0	163.2

expected, the influence of order of birth or of other factors associated with it is revealed in the proportion by which the actual deaths fall short of or exceed the expected deaths. The figures in Table II show the actual deaths in comparison with deaths when the influence of age of mother is eliminated.

The explanation of this calculation can be phrased in other terms. The series of ratios show, in fact, the influence of order of birth (together with associated factors) when the effect of the disproportionate weighting of the various groups with births to younger or to older mothers is eliminated, or, more simply, when the influence of age of mother is eliminated from the relative rates.

The effect of eliminating the influence of age of mother appears slightly to diminish the excess mortality of first as compared with second births, and to lessen the excess mortality of births of later as compared with births of earlier orders. The influence of order of birth, though diminished, is still marked.

Table III presents a similar computation showing the influence of order of birth after additional factors are eliminated, to wit, earnings of father and plurality of birth. The computations made in constructing this table are much more complicated than those made in constructing the preceding one, since each group of births classified by earnings of father, order of birth, and age of mother is multiplied by the average rate in the corresponding earnings-of-father and age-of-mother group; the results are then totaled to give the expected deaths by order of birth. These expected deaths are the numbers that would be expected if full weight were given to the factors age of mother and earnings of father, but if no influence of order of birth were present. The differ-

TABLE III

RELATIVE MORTALITY BY ORDER OF BIRTH, WHEN INFLUENCES OF AGE OF MOTHER AND EARNINGS OF FATHER ARE ELIMINATED; SINGLE LIVE BIRTHS IN SEVEN CITIES

Order of birth	Deaths		
	Actual	Expected	Ratio of actual to expected
Total	2,196	2,196.0	100.0
First	586	589.8	99.4
Second	410	454.3	90.2
Third	297	302.3	98.2
Fourth	232	232.9	99.6
Fifth	175	168.7	103.7
Sixth	119	124.0	96.0
Seventh	108	95.9	112.6
Eighth	75	71.6	104.7
Ninth	61	54.5	111.9
Tenth and later	133	101.8	130.6

ences between the actual and expected deaths show, as before, the influence of order of birth after the disturbing effects of these other factors have been eliminated.

It is of interest to note that the general trend of the rate by order of birth remains unaltered; the first births have a slightly higher rate than the second, and from the second there is a general tendency to increase with the later orders. The elimination of the two additional factors—earnings of father and plural birth—tends, however, to reduce still further the influence of order of birth as compared with that indicated by the original averages.

A second question concerns the influence of age of mother. Table IV presents the relative ratios between the average rate and the rates

TABLE IV

RELATIVE MORTALITY BY AGE OF MOTHER, WHEN INFLUENCE OF CERTAIN OTHER FACTORS IS ELIMINATED; LIVE BIRTHS IN EIGHT CITIES

Age of mother	Ratio of actual to expected deaths		
	On basis of average rate	Eliminating influence of order of birth	Eliminating influence of order of birth, earnings of father, and plural births
Total	100.0	100.0	100.0
Under 20	121.2	131.8	121.3
20–24	98.5	106.8	101.9
25–29	91.2	95.2	95.5
30–34	94.2	90.4	93.3
35–39	113.8	97.5	105.3
40 and over	122.9	92.4	91.1

for each age-of-mother group, first with no eliminations, second, when the influence of order of birth is eliminated, and third, when the influences of order of birth, earnings of father, and plural births are eliminated.

The effect of eliminating the influence of order of birth appears in the removal of the high mortality rate among the older mothers, which appears to be due largely to the influence of the high mortality rate attending births of late orders. The effect of eliminating the influence of earnings of father appears in lessening the excess mortality among the young mothers, a large proportion of whom are in families with low earnings.

Since the primary purpose of this paper, as stated above, is to illustrate the application of Professor Westergaard's method of isolating the influence of the several factors, these examples may perhaps suffice. They are not intended to suggest that the analysis made is sufficient, but are presented to show how the method can be applied to eliminate

one, two, or more factors. As many factors should be eliminated as a thorough consideration of the problem shows to be necessary. In many cases, however, the limitations in the amount or in the character of material available do not allow the exhaustive analysis that the nature of the problem requires.

One suggestion might be made as to an appropriate notation to express the operations and results of multiple classification and of the method of expected deaths. Letting 1 denote the infant mortality rate, 2 order of birth, 3 age of mother, 4 earnings of father, 5 nationality of mother, 6 plural births, and similar subscripts for other factors, then Table I, for example, may be designated briefly B 2.3, or births classified by age of mother and order of birth. If subclassification by nationality of mother is introduced the table becomes B 2.3–5. Letting R denote the series of ratios of actual and expected deaths that shows the influence of a given factor such as order of birth upon the infant mortality rate, then the relation between the rate and order of birth may be stated simply $R_{1.2}$; if a factor such as age of mother is eliminated, it may be indicated by placing the corresponding number after a colon following the numbers indicating the relation shown, thus $R_{1.2:3}$. The third column of ratios in Table IV, for example, may be designated, $R_{1.3:2\text{-}5\text{-}6}$.

Among the limitations of the method considered in this paper may be mentioned the following points: (1)The method requires a considerable amount of computation if more than one or two factors are eliminated; (2) the application of the method requires a mass of material commensurate with the number of factors to be eliminated, though no more than would be required by any other equally satisfactory method; (3) since it is an averaging process the method will yield satisfactory results only when an average is appropriate.

The last point may be illustrated by Table V, which shows infant mortality rates classified by age of mother and order of birth. Among births to young mothers the rate of infant mortality rises sharply from first to third; while among births to mothers of the oldest groups shown the rate, high for first births, falls to a minimum for third births and rises to a very high figure for births tenth and later in order. These characteristic variations of the rate are obscured by an averaging process,[1] unless such a process takes into account the interval between births which also enters as a factor in this case. Again, the averaging

[1] In mathematical terms, the partial derivative which measures the contribution of X_2 to X_1 when other factors are held constant may in general contain constant terms in X_3, X_4, and other factors. The condition that the partial derivative shall not vary with X_3, X_4, etc., requires an averaging process to find an expression for $\frac{\delta X_1}{\delta X_2}$ that contains no terms in any other variable. Such a process is ap-

process indicated (Table IV) that age of mother was not an unfavorable element in the rate of mortality among infants of older mothers; but the classified table of rates shows that for first births the infant mortality rate is higher among births to older mothers than to mothers between 25 and 29 years of age.

A further difficulty arising from this averaging process is the question of the effect of the weights chosen. The results, as can easily be

TABLE V

INFANT MORTALITY RATES, BY AGE OF MOTHER AND ORDER OF BIRTH; LIVE BIRTHS IN EIGHT CITIES

Order of birth	Infant mortality rate[1]						
	Total	Age of mother					
		Under 20	20–24	25–29	30–34	35–39	40 and over
Total	111.2	135.7	109.3	101.4	104.7	126.5	136.7
First	104.7	125.5	100.5	90.4	102.8	131.6	.....
Second	95.7	167.2	105.6	74.0	76.8	112.7	.....
Third	104.6	.....	125.0	103.8	82.1	73.1	.....
Fourth	108.8	.....	155.3	99.7	106.6	82.1	.....
Fifth	118.8	.....	97.7	136.2	96.7	127.5	.....
Sixth	122.7	.....	.....	150.4	102.1	128.8	.....
Seventh	136.8	.....	.....	195.7	121.8	131.3	108.9
Eighth	135.9	.....	.....	.....	137.2	121.1	.....
Ninth	146.8	.....	.....	.....	174.6	133.9	.....
Tenth and later	181.5	.....	.....	.....	228.1	193.6	159.6

[1] Rates are not shown where base is less than 100.

shown, may vary considerably according to the weights. In this respect the method has the same advantages and the same weaknesses as the method of standardizing or correcting death rates, or of measuring price increases. Experience has indicated as a general rule to be followed that the weights chosen should agree as closely as possible with the "natural" weighting in the problem studied. Thus, if it is desired to eliminate the influence of age of mother, the actual weighting of the births by order of births and age of mother yields the most satisfactory results and introduces no new element of arbitrary weighting into the problem. Care must always be exercised, however, in applying the method to determine whether the results are affected by the weights. Errors of interpretation arising from these difficulties

propriate only when the types and values of the partial derivative do not vary materially for different values of other variables.

If the additional condition is imposed that the partial derivative with respect to each factor be a constant, the expression becomes linear and corresponds to the familiar partial straight line regression equation $X_1 = b_{12.34} \ldots X_2 + b_{13.24} \ldots X_3$, etc.

It is clear that the application of the Westergaard method is somewhat broader than that of the partial straight line regression equation, and that the latter is equally inapplicable to cases in which an averaging process obscures the true significance of the variations in the rates.

can always be avoided by a study of the rates classified by the several factors.

Among the advantages of the method are the following: (1) The results are stated in clear and simple terms; (2) the numbers upon which the results are based can be presented and the validity of the result judged thereby; (3) the method requires the constant use of the original material, which often suggests the necessity of taking into account factors, such as age of infant in connection with type of feeding, which might otherwise be overlooked; (4) it can be applied in certain cases even when the material cannot be classified so as to yield the full detail of rates; [1] (5) it is not restricted to linear relationships but indicates any type of average relationship which may exist; (6) it is not restricted to factors which can be expressed numerically but can be applied equally well to factors, such as nationality and employment of mother, which are not susceptible of statement in numerical terms; and (7) it places in true relation the actual effect of each contributing factor after the influences of other factors have been eliminated.

[1] For example, if the births can be fully but the deaths or stillbirths only partially classified. See Westergaard, *op. cit.*, Revised ed., pp. 333, 336; and "Scope and Method of Statistics," *loc. cit.*, p. 262.

NOTES

DISTRIBUTION OF MEN PHYSICALLY UNFIT FOR MILITARY SERVICE

By Rufus S. Tucker

The publication of the results of the examinations of drafted men in the recent war has furnished fresh material for the old arguments concerning the relative healthfulness of urban and rural life and the physical strength and resistance of the various races found in this country. As is usual in such cases, the statistics can be interpreted variously, even assuming their completeness and accuracy. As a result, many decided opinions have been put forth without much to back them and have been accepted or criticized according as they did or did not fit with the general ideas or local patriotisms of the reader. This article is an attempt to criticize these statistics and to suggest some conclusions which, though not proved, seem probable.

The most complete analysis of draft statistics is to be found in the War Department's publication, *Defects Found in Drafted Men*, prepared under the direction of Majors A. G. Love and C. B. Davenport and published in 1920. Other sources of information, frequently at variance with the preceding material and with each other, are the "Second Report" of the Provost Marshall General, dated December 20, 1918, and the "Final Report" of the same official, dated July 15, 1919. None of these, in my opinion, furnishes sufficient information for sound deductions concerning the physical condition of specific sections or classes of our population, for reasons to be explained.

Mr. Love and Mr. Davenport, realizing the variations in standards of local examining physicians, did not publish the ratio of cases of rejections or disabilities to the total number of men actually examined. They based all their ratios, instead, on a hypothetical total, or rather, two hypothetical totals, one of 3,241,987, the other of 2,753,922—the one for the comparison of rejections, the other for the comparison of defects. These hypothetical totals were obtained by assuming that the men who had been passed by the local boards and who were not reëxamined at a cantonment would have been rejected (or found defective) on reëxamination at camp in the same proportion that had obtained in actual examinations of other men from their states. On

this assumption they arrived at a hypothetical number of rejections for each state, which, unfortunately, they did not publish. They did, however, publish the actual number of rejections and the ratio of the assumed rejections to the number of registrants examined by local boards in each state. Dividing the actual rejections by these ratios, and adding the states together, gives the hypothetical total mentioned above. It is important to note that the number of actual examinations considered by them is 1,961,692 at the camps plus 549,099 rejections and 1,253,310 acceptances by local boards, a total of 3,764,000 cases. There were 705,000 other men sent to camp, whose records, although available, were not analyzed.

The Provost Marshall General's figures for physical rejections, in his Final Report, are based on a total of 17,593,778 men classified, but not more than 6,554,000 of these were examined physically,[1] and these local examinations were very uneven in quality. The analyses in the Provost Marshall General's Second Report are based on only 3,218,000 examinations.

The proportionate numbers of rejected men by states given in these reports cannot be accepted as correct indexes of the condition of the population of those states, since they omit the large number of men who were never examined by the draft officials, either of the local boards or of the camps, because they were already in the service. There were about 1,850,000 of these,[2] all of course physically fit; and inasmuch as the proportion of volunteers to the number of men physically examined by draft officials in each state differed greatly, their omission seriously altered the relative standing of the states. Some of these men may have had physical defects of some sort, but it is obvious that these were not sufficient to cause rejection. Unfortunately the exact districts from which these men came cannot be ascertained; they are grouped by states only. Moreover, there is no way of ascertaining how many were within the age limits 21 to 31. It is possible, however, to obtain totals by states of all men, 18 to 45 years of age, who joined the army or the navy after registering for the draft, and comparisons that take these men into account are, I believe, more significant than the published ones. To omit the volunteers would be as misleading as if a milk inspector should attempt to compare samples some of which had been skimmed and some not, for there is no doubt that they were, physically at least, the cream of the popu-

[1] It is impossible to reconcile the figures given in different parts of the Provost Marshall General's reports on this and many other points, partly because of obvious errors in arithmetic, partly because of insufficient explanation. Incidentally, nearly all the charts accompanying the Final Report have incorrect titles.

[2] There were 378,619 in the military or naval service at the outbreak of war (*P. M. G. 2d Report*, p. 227); and 1,471,076 volunteers during the war (*P. M. G. Final Report*, p. 14).

lation. The importance of allowing for these men is apparent if one considers that they were equal in number to over 28 per cent of the total examined by draft officials. The relative standing of states is affected much more by this factor than by the differences in local standards which the War Department report is so careful to eliminate; for the proportion of rejections at camps averaged only 7 per cent of those reëxamined, varying from 2.6 per cent to 11 per cent in different states, and amounted to only 138,000 men in all; whereas the proportion of volunteers varied from about 20 per cent in South Carolina to over 55 per cent in the District of Columbia, and the total number was, as already stated, about 1,850,000. The omission of volunteers from the averages gives an especially misleading impression of Oregon, Rhode Island, and Massachusetts.

It would be possible to work out from the Surgeon General's report the assumed number of rejections and to obtain a table of rejection ratios by dividing this number by the sum of those examined by the local boards and the volunteers. But only one third of the local boards' examinations need to be corrected for low standards, as 1,962,000 of them were revised by camp examiners; and there is no way of telling whether the 549,000 rejections by local boards included many cases that should not have been rejected. Moreover, it is not certain that the number of rejections at camp of men passed by local boards is not partly a result of the idiosyncracies of camp examiners as well as the carelessness or the incompetency of local doctors. It is also far from certain that the proportions rejected on reëxamination at camp would be the same for each state if the remaining men had been examined as the proportion rejected of the "second million," as is assumed by the authors of the Surgeon General's report. The "first million" and the "second million" showed striking differences in this respect.

It is probable, as the official report states, that the examinations, both local and at camp, were abnormally severe in New England and New York. On the other hand, Maine, Michigan, Missouri, Virginia, South Carolina, Georgia, Kentucky, Alabama, Mississippi, Oregon, and California were less strict than other states contributing to the same cantonments, and Camps Meade, Lee, Taylor, Dodge, Funston, and Pike are thought not to have been so strict as the other camps.[1] In general, the states that furnished the most volunteers also had careful examinations. Finally, it must be borne in mind that there were a great many men between the ages of twenty-one and thirty-one who enlisted in the army, navy, national guard, or marine corps before the

[1] See *Defects*, pp. 44, 193, 194, 197; *2d Report, P. M. G.*, p. 164.

draft registration date, and who were therefore not included in the draft statistics. It is estimated that there were 625,000 such cases,[1] but there is no way of apportioning them to states. The percentage of rejections for the United States as a whole would be 13.1 per cent of the men 21 to 31 years of age if this estimate is correct.

For the foregoing reasons it has not seemed worth while to attempt to obtain more correct ratios of rejections of men aged 21–31, but rather to attempt an analysis of those aged 18–45 on the basis of the figures contained in the reports of the Provost Marshall General.

TABLE I

PROPORTION OF ALL MEN EXAMINED WHO WERE REJECTED ON ACCOUNT OF PHYSICAL OR MENTAL DISABILITY (7,019,000 CASES)

Order of state	State	Per cent	Order of state	State	Per cent
1	Arizona	20.24	26	Mississippi	13.18
2	New Mexico	20.14	27	Delaware	13.13
3	Maine	19.74	28	Utah	13.04
4	Georgia	19.05	29	Iowa	12.63
5	Colorado	18.83	30	Oregon	12.49
6	Tennessee	18.63	31	Minnesota	12.48
7	Rhode Island	18.56	32	Pennsylvania	12.43
8	Michigan	18.20	33	Nebraska	12.19
9	Vermont	17.22	34	West Virginia	12.18
10	Virginia	16.07	35	New Jersey	12.12
11	Kentucky	15.95	36	North Dakota	12.10
12	South Carolina	15.84	37	Texas	11.91
13	Washington	15.77	38	Florida	11.21
14	North Carolina	15.64	39	Idaho	10.84
15	Maryland[1]	15.22	40	Nevada	10.74
16	New York	14.49	41	Arkansas	10.68
17	Louisiana	14.38	42	Ohio	10.52
18	District of Columbia	14.34	43	Alabama	10.43
19	Connecticut	14.19	44	Montana	10.40
20	Missouri	14.06	45	Kansas	10.27
21	South Dakota	14.05	46	Indiana	9.88
22	Massachusetts	13.87	47	California	8.58
23	New Hampshire	13.47	48	Wyoming	7.40
24	Illinois	13.27	49	Oklahoma	7.00
25	Wisconsin	13.27			
				Average of United States	13.19

[1] Based on the number of rejections given in the Surgeon General's report, p. 417. The Provost Marshall General's figures for this state are contradictory and obviously erroneous.

Since the number of men involved is much larger, and since many of them were examined by regular army or navy surgeons, the effect of local variations in physicians' standards will presumably be minimized. This analysis has been made by adding to the number of men registered in each state the number not registered on account of being members of the national guard in federal service on April 1, 1917, or having enlisted in the national guard or the regular army between April 2 and June 30, 1917. There is a certain amount of duplication here on account of those who enlisted after registering on June 5. There is also included a very small number of men over 45 years of age. On the other hand, those who, without registering for the draft, enlisted in the navy or the marine corps or in the regular army before April 1,

[1] *P. M. G. 3d Report*, p. 31.

or in any branch of the service after July 1, 1917, are not included, as there are no statistics available. The result of this analysis is given in Table I, which shows the condition of all men of military age, 18 to 45, who were physically examined by draft officials, and nearly all of those who were examined by recruiting officers not connected with the draft. Table II presents for comparison the order of the states and ratios published by Love and Davenport, and by the Provost Marshall General in his Second Report.

Accepting Table I, then, as best representing the physical condition of the male population of military age in the different states, what can we deduce as to the causes of the differences between states? It

TABLE II

PROPORTION REJECTED ON ACCOUNT OF PHYSICAL OR MENTAL DISABILITY

Surgeon General's Report (3,764,000 cases)			Provost Marshall General's Report (3,218,000 cases)		
Order of State	State	Per cent	Order of state	State	Per cent
1	Rhode Island	42.44	1	Arizona	34.90
2	Vermont	35.39	2	Rhode Island	28.67
3	Maine	34.60	3	Michigan	23.18
4	Massachusetts	26.73	4	Washington	22.83
5	California	26.50	5	Vermont	22.55
6	Washington	26.28	6	Colorado	21.94
7	Tennessee	24.56	7	California	21.66
8	Virginia	24.56	8	Connecticut	20.79
9	Maryland	24.43	9	New York	19.31
10	New York	24.05	10	Massachusetts	18.34
11	Louisiana	23.91	11	Virginia	18.31
12	Michigan	23.31	12	Maryland	18.27
13	Connecticut	22.66	13	South Carolina	17.24
14	Georgia	22.51	14	Maine	17.16
15	South Carolina	22.25	15	Tennessee	16.72
16	Oregon	21.98	16	Missouri	16.53
17	Utah	21.93	17	Georgia	16.16
18	Colorado	21.35	18	New Jersey	15.82
19	North Carolina	21.34	19	North Carolina	15.68
20	Pennsylvania	20.93	20	Minnesota	15.37
21	New Jersey	20.89	21	Illinois	15.35
22	Kentucky	20.73	22	Texas	15.29
23	Missouri	20.69	23	Indiana	15.29
24	New Mexico	20.66	24	Wisconsin	15.25
25	Iowa	20.41	25	Pennsylvania	15.12
26	New Hampshire	20.31	26	North Dakota	14.91
27	Illinois	20.25	27	Oregon	14.65
28	Wisconsin	20.04	28	Kentucky	14.64
29	Florida	19.98	29	West Virginia	14.52
30	Mississippi	19.98	30	Florida	14.50
31	Delaware	19.80	31	Idaho	14.44
32	Minnesota	18.97	32	Utah	14.42
33	Ohio	18.79	33	New Mexico	14.39
34	South Dakota	18.76	34	Nevada	14.27
35	Nevada	18.60	35	Mississippi	14.06
36	Oklahoma	18.49	36	Iowa	13.96
37	Indiana	18.35	37	Louisiana	13.94
38	Idaho	17.96	38	Ohio	13.81
39	Alabama	17.96	39	New Hampshire	13.59
40	West Virginia	17.76	40	Alabama	13.55
41	Texas	17.59	41	Arkansas	13.08
42	North Dakota	16.70	42	Delaware	12.94
43	Arkansas	16.39	43	Nebraska	12.91
44	Montana	16.27	44	Montana	12.68
45	District of Columbia	16.25	45	Kansas	12.37
46	Arizona	15.33	46	Wyoming	12.36
47	Kansas	14.73	47	South Dakota	12.13
48	Nebraska	13.46	48	District of Columbia	11.56
49	Wyoming	12.81	49	Oklahoma	9.78
Average of United States		21.21	Average of United States		16.25

is very misleading to assume without question that race is the determining factor, and to assert, as Love and Davenport have done, that because the census shows a certain race to be very numerous in a certain district, that race is responsible for the showing made by that district. This deduction is reasonable enough in the case of Indians, negroes, and native whites of foreign parentage, who were subject to the draft law, but is not so justifiable in the case of the foreign-born, since only about one half of them were subject to the draft. Of course the analysis by sections, given by Love and Davenport, is further vitiated by the omission of voluntary enlistments.

Of the fifteen states that have the highest proportion of negroes in their population, nine [1] show a very high proportion of rejections, in spite of the fact that several of them are supposed to have had medical examiners who were rather easily satisfied. Members of other colored races are too few in number to affect the relative standing of states, unless the Indians in Arizona have something to do with the poor showing of that state.

Of the twelve highest states, in proportion of rejections, seven [2] have an unusually large number of native whites of native parentage, and [3] of the lowest twelve, eight show the same phenomenon. Plainly, this proves nothing. Looking at the same problem from another angle we find that five [4] of the high states have an unusual proportion of natives of foreign or mixed parentage; while of the low twelve,[5] six have large numbers of that class. These ambiguous results are probably due principally to the fact that where foreigners are numerous, negroes are scarce, and vice versa, although there is reason to believe that some of the foreign nationalities differ little from the native stock.

Even if the fifteen states with large negro populations be taken out of consideration, it is difficult to prove a correlation between foreign racial elements and physical disability. The figures are inconclusive: they seem to show that native whites of native parentage are slightly superior to those of foreign origin, but there are so many factors involved that no certain conclusions can be established. The study of selected districts by the Provost Marshall General in his Second Report is in some respects more convincing, but is far from decisive. It is to be hoped that the War Department will see fit to analyze its records of individuals in the service according to color, place of birth, and resi-

[1] Md., D. C., Va., N. C., S. C., Ga., Ky., Tenn., La. These and following statements are based on the census of 1910 unless otherwise indicated.

[2] Me., Vt., Va., Ky., Tenn., Colo., and N. M.

[3] Ind., Ohio, Kans., Ala., Ark., Okla., Idaho, and Wyo.

[4] Vt., R. I., Mich., Colo., and Ariz.

[5] Ohio, Kan., Mont., Idaho, Wyo., and Calif.

dence, and to publish average heights and weights, and the color of hair and eyes.

With reference to the relative standing of rural and urban states we find that of the twelve states highest in their ratio of rejections, three [1] were in 1910 more urban than the United States as a whole, and of the twelve lowest only two [2] were more urban. The corresponding figures for 1920 are two [3] and two. It is evident that these figures do not prove any superiority of the country over the city. The problem is complicated by the predominance of natives in the country and of

TABLE III

PROPORTION REJECTED ON ACCOUNT OF MENTAL OR PHYSICAL DISABILITY, AGE 18 YEARS (247,000 CASES)

Order of state	State	Per cent	Order of state	State	Per cent
1	Ohio	10.0	26	Kansas	2.9
2	Tennessee	8.1	27	Virginia	2.8
3	Rhode Island	6.9	28	West Virginia	2.8
4	Iowa	6.2	29	Illinois	2.8
5	North Dakota[1]	6.0	30	South Carolina	2.7
6	Delaware[1]	5.8	31	Pennsylvania	2.7
7	Nebraska	5.7	32	Maryland	2.5
8	Connecticut	5.3	33	Mississippi	2.2
9	Vermont[1]	5.3	34	New Jersey	2.2
10	Maine[1]	5.2	35	Texas	2.0
11	Kentucky	5.1	36	Florida	1.9
12	Georgia	4.9	37	Missouri	1.7
13	New York	4.9	38	Minnesota	1.7
14	New Hampshire[1]	4.9	39	Washington	1.6
15	Oregon	4.6	40	Arkansas	1.5
16	North Carolina	4.4	41	Montana	1.5
17	Wisconsin	4.4	42	Louisiana	1.4
18	Oklahoma	4.0	43	Nevada[1]	1.3
19	Colorado	3.9	44	Indiana	1.3
20	Massachusetts	3.9	45	California	0.3
21	District of Columbia[1]	3.7	46	Idaho	0.1
22	Michigan	3.6	47	New Mexico[1]	0.0
23	Utah	3.5	48	Wyoming[1]	0.0
24	South Dakota	3.1	49	Alabama	0.0
25	Arizona[1]	3.1			
				Average of United States	3.3

[1] Less than 1,000 men of this age examined in this state.

foreigners in the cities, and by the fact that the negro population is mainly rural. In addition it is necessary to consider the extent of selection as a result of internal migration.

It would seem reasonable to expect a correlation between the growth of a state by internal migration (*i. e.*, the accession of natives of other states) and its physical rating, on the ground that the most vigorous are most likely to seek their fortunes away from home. At first sight there is a correlation; of the twelve physically superior states nine gained more residents than they lost through interstate migration, and of the twelve inferior states seven lost more than they gained in the period between 1900 and 1910. The coefficient of correlation between the proportion of physical rejections, as given in Table I, and the proportion of American-born residents who were born in other states, according to the census of 1910, is $-.256$, with a probable

[1] R. I., Mich., and Colo. [2] Ohio and Calif. [3] R. I. and Mich.

error of 0.089. Moreover, if the Provost Marshall General's Final Report be studied, it is evident that interstate migration must affect the number of physical rejections to some extent, for in many of the states that lost by interstate migration the physical examinations of the eighteen-year-old class show much more favorable results, compared with other states, than those of the total draft. This is especially true of Missouri, Maryland, Virginia, Alabama, South Carolina and Louisiana. Table III gives the ratio of physical rejections in the eighteen-year-old class to the total number examined of that age, including those who volunteered after registration but not those who never registered, as that cannot be ascertained. The figures are taken from page 28 of the Final Report of the Provost Marshall General. It seems plain that there is a strong selective influence at work here, very likely strong enough to obscure the effect of foreign immigration in most states.

The results of this analysis are necessarily tentative. No satisfactory analysis can be made on the basis of the published figures. Those figures are very useful and probably sufficiently accurate for the medical man who wishes to study the frequency and geographical distribution of specific diseases and defects; but for the sociologist, who is interested in men as a whole—their size, strength, and general vigor—and in the relation between these factors and the elements of race, climate, and occupation, they are sadly deficient. On the whole, they seem to show a superiority of the native white stock over the immigrant strain; and they almost certainly show a superiority of whites over negroes. They do not support the views put forth, in Love and Davenport's report, concerning the superiority of southern agricultural whites, Indians, Mexicans, and natives of German or Scotch origin, and of rural districts in general as compared with urban; neither do they prove the inferiority of French Canadians. They are, however, consistent with Love and Davenport's conclusions as to the freedom from defect of the northern native white agricultural districts and the Scandinavian groups, and the relative excess of defects among the negroes and the mountain whites of the Appalachians. Finally, they seem to indicate that Americans living outside the state of their birth are, as the result of a selective process, physically superior to the stay-at-homes; and that, in consequence, the rapidly growing states are superior to those with more nearly stationary populations; but they do not indicate that the inferiority of the latter has developed into racial degeneracy on the part of the native whites, except possibly in some parts of Maine, Vermont, Georgia, Kentucky, and Tennessee.

PRE-WAR UNEMPLOYMENT STATISTICS: A CRITIQUE

By Hornell Hart, *Iowa State University*

In the March (1922) number of this Journal,[1] W. A. Berridge states that "no writer on unemployment or on the business cycle has ever undertaken a rigorous quantitative analysis of the American data on unemployment." In a footnote he then refers to a monograph by the present writer, and says:

> Mr. Hart's study is comprehensive and highly laborious, but is unfortunately foredoomed to failure by the nature of the method employed. He seeks to measure the total volume of unemployment by subtracting the total "volume of employment" from the total "normal labor supply" in the United States. In both of these large quantities there are considerable errors of estimation, which of course assume a much greater relative magnitude when applied to the difference between the two quantities.

Inaccurate and misleading references such as these might well, under certain circumstances, be ignored. The monograph on *Fluctuations in Unemployment in Cities of the United States, 1902 to 1917*, has, however, been the only attempt at a quantitative study in this field, and has frequently been used by other writers as a basis for deductions. The article following Mr. Berridge's, for example, quotes its figures as authoritative. Inasmuch, therefore, as Mr. Berridge rejects the method on which those figures were based, and presents indexes of his own for the years 1903 to 1916 and 1919 to 1921 which he considers "fairly typical of industrial activity in this country" and which he believes "measure relative fluctuations in employment with high accuracy,"[2] the question of what figures should be accepted on unemployment for this period becomes worthy of attention by students of economic statistics and economic history.

In view of the fact that Mr. Berridge has put forth a "rigorous quantitative analysis of the American data on employment and unemployment," it is somewhat disconcerting to stumble upon misquotations and an incorrect reference in his footnotes, to find him using such expressions as "the coefficient of correlation was +85 per cent, 5 per cent lower than that between the two employment curves," and to note that he fails consistently to state the probable errors of his coefficients of correlation. Still more disconcerting is it to observe that in his weighted index of cycles of unemployment, which is apparently made up of deviations from trends, and which is headed "Unit:

[1] Vol. XVIII, p. 42.

[2] *Rev. of Economic Stat.*, IV, p. 46 (Jan., 1922).

one standard deviation," the arithmetic mean of the series is +.15, and the standard deviation is .89, instead of being 0 and 1.0 respectively as one might expect. Such eccentricities make it rather difficult to put any intelligible interpretation upon the items in the index.

Technical inaccuracies are not, however, the essential objections to Mr. Berridge's pre-war unemployment index. Such errors are doubtless to be expected from inexperienced statisticians. The fundamental difficulties have to do with the essential unsoundness of his methods. In this article I shall undertake to make clear the following points:

1. Mr. Berridge's weighted index of unemployment for January, 1903, to June, 1916, correlates less closely with his own bureau's "Price Index of Business Cycles" for the same period than an index based directly upon the data used in my monograph published three and a half years earlier.

2. Correlation with any index of business cycles is not an adequate criterion of the value of an index of unemployment.

3. The elimination of seasonal variations from an employment index vitiates the index as reflecting employment conditions and is defensible only as a means of analysis. The final index should show actual fluctuations from all causes.

4. The use of the trend, as employed by Mr. Berridge, involves dangerous assumptions and leads to absurdities, which are avoided by the method used in my index.

5. The data upon which Mr. Berridge's index is based are a fundamentally biased sample, and cannot be trusted to reflect actual fluctuations of unemployment in the United States.

In January, 1922, Mr. Berridge published a table entitled "Cycles of Unemployment in All Trades and in Selected Trades in New York State, 1903–16."[1] In the discussion of that table he devoted a great deal of attention to the correlations between his index and various indexes of business prosperity. In November, 1921, his organization published "A Commodity Price Index of Business Cycles" which, the authors assert, "gives us an accurate record of the fluctuations of business and industry in general, exclusive of agriculture."[2] My monograph was published in May, 1918.[3] As one test of the relative soundness of Mr. Berridge's and my indexes, I have calculated, by the Pearson method, the correlation between Mr. Berridge's index and the deviations of the price index of business from its trend for the period

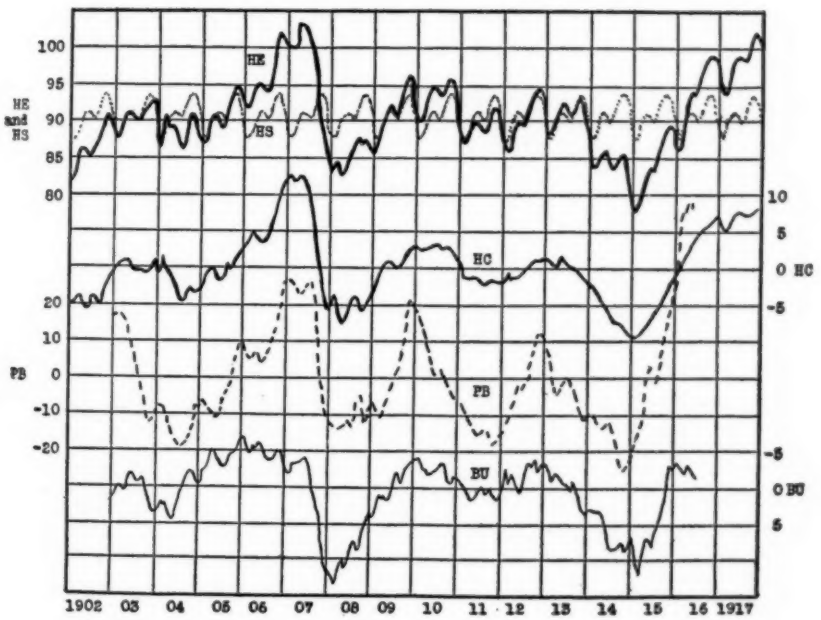
[1] *Rev. of Economic Stat.*, IV, pp. 46–49.

[2] Warren M. Persons and Eunice S. Coyle, *Rev. of Economic Stat.*, III, pp. 353–69.

[3] "Fluctuations in Unemployment in Cities of the United States, 1902 to 1917," Studies from the Helen S. Trounstine Foundation, vol. 1, pp. 47–59.

covered by Mr. Berridge's index, and the correlation between my index for the same dates, in the form designated in the accompanying table as "C," and the deviations of the price index of business from its trend. The Berridge index correlates with the business index $-.52 \pm .04$. My index correlates with the business index $+.65 \pm .03$.

While these coefficients remove any basis for supposing that Mr. Berridge's index deserves to be substituted for data already in the field, correlation with business indexes cannot be considered an adequate criterion for judging the value of unemployment indexes. What should be sought in such an index is not a new means of measuring prosperity, but a reliable method of measuring the relative, and if possible the absolute, extent of unemployment at given dates, with a view to more accurate study of the problem, and ultimately the prediction of conditions at future dates. The number of persons unemployed is conditioned not only by the degree of general business prosperity but also by fluctuations in the supply of labor, by seasonal fluctuations in demand, by industrial disputes, and by other conditions. Prosperity and depression, moreover, act with different degrees of



NON-AGRICULTURAL PRE-WAR EMPLOYMENT AND BUSINESS CURVES

HE is Hart's percentage which the volume of non-agricultural employment constitutes of the normal labor supply. HS shows averages of HE by calendar months. HC is HE minus HS.
PB shows deviations of Pearson's Price Index of Business from its trend for the dates shown.
BU is Berridge's index of "Cycles of Unemployment" inverted.

rapidity on different employments and industries. The correlation between a perfect unemployment index and a perfect index of business prosperity would, therefore, be far less than unity. Mr. Berridge's interest in the business cycle has led him to eliminate and discard the seasonal fluctuations in his unemployment data, and he has ignored fluctuations in the supply of labor, with the result that his index does not reflect real employment conditions. The relative importance of seasonal variations may be seen in the accompanying chart.

The use of the trend by Mr. Berridge brings out a fundamental difference between his method and mine. The statistician in this field must cope with two fundamental problems: First, how he may secure reliable data on fluctuations in the volume of employment; and second, how these fluctuations may be turned into reliable measures of unemployment. In dealing with the second of these problems the United States Census of Manufactures has used the method of showing the relative numbers of persons employed in each month of the year of the census as compared with the month of maximum employment. This method ignores the facts that serious unemployment often exists in the peak month, and that population is constantly growing. A second method might be to measure deviations from a straight line drawn from peak to peak in the employment curve. This would ignore unemployment at the peaks and would make the false assumption of straight-line growth in the labor supply from peak to peak.

The solution which Mr. Berridge offers to this problem is to state his index of unemployment in terms of deviations from the trend. He seems to be under the delusion that he thereby avoids the necessity of making assumptions as to variations in the supply of labor. As a matter of fact, however, the use of the trend is in itself an assumption that the supply of labor is proportional to the ordinates of the straight line of closest fit to the curve of demand for labor. This is demonstrably untrue, and leads to absurdities. Changes in the supply of labor depend upon the birth rate, death rate, legal minimum age of employment, age of retirement from industry, immigration and emigration rates, and other factors. During the period of Mr. Berridge's index these conditions were changing at different rates, and in different directions. Migration, in particular, was fluctuating widely.

My own method of measuring unemployment was to build up a base line by means of careful estimates of changes in the supply of urban labor, and to state unemployment in terms of deviations in the demand for labor from this normal supply line. Mr. Berridge carelessly characterizes this method as "foredoomed to failure," but he does not escape the difficulty by substituting, for the supply of labor,

the trend of employment as a base from which to measure deviations. He simply declines to use available knowledge to minimize error, and uses a crude base where a more exact one is available.

The absurdities to which the use of the trend lead are obvious from the fact that as new data are added the trend must constantly be altered. The trend employed in Mr. Berridge's index was valid for the period January, 1903, to June, 1914, but when he added two more years the trend did not fit. My method provides a base line which is not vitiated by the addition of subsequent data and which responds flexibly to every important change in the labor supply. Another difficulty with the trend is that it often represents factors which should be conserved instead of eliminated. There is good reason for believing that the trend in employment from 1903 to 1915 represents a real increase in unemployment; by eliminating such a trend Mr. Berridge falsifies the facts in which he is interested. Factors of this sort are conserved by the method which I used.

Mr. Persons uses a straight line trend in his price index chart of business cycles for the years 1897 to 1912, but apparently recognizes that the method is not valid for preceding and succeeding years. Indeed, the use of the trend here seems to be merely a crude and unsatisfactory method of eliminating the factor of inflation and contraction of the currency, just as Mr. Berridge's trend is a crude and unsatisfactory method of eliminating changes in the labor supply as a factor in unemployment.

Not only in the treatment but also in the selection of his data Mr. Berridge has failed to grapple adequately with the problem. His prewar index is based upon the reports of the percentages of union members unemployed, from six trades, representing "only one third or one fourth the total number of union members in New York State." In assuming that this index is "fairly representative of industrial unemployment in the country as a whole" he assumes that the returns themselves are reliable, that the unions reporting are typical of all the unions in these trades, that unemployment among union men is typical of unemployment among non-union men, that the six trades represented are typical of industry as a whole in New York State, and that New York State conditions are typical of the nation as a whole. All of these assumptions are questionable. The union men employed in railroading, for example, have entirely different employment fluctuations from the non-union men.

The data upon which my index is based include national statistics on manufacturing employment for every fifth year, national statistics on transportation, mining, and quarrying, and local data from nine

representative states. It will not do to characterize this method as "comprehensive and highly laborious," and then fall back upon union reports for one class of labor in six trades in one state as a general index of unemployment. Elaborate technique is a vice unless used merely as the instrument of a worker having clear insight into the problem, for the analysis of sound and representative data.

The index of unemployment shown in the accompanying table is merely the best index yet available. It can be greatly improved, but its betterment depends upon greater comprehensiveness and thoroughness in the analysis of available data. Researches in this direction, now under way by other students, will doubtless soon supersede this index.

The above article was written before the second installment of Mr. Berridge's article in the June number of the JOURNAL was available.[1] In that installment Mr. Berridge has improved his previous pre-war index by adding data from Massachusetts and New Jersey, thus partially offsetting the criticism relating to the inadequacy of his basic data. It should be noted, however, that all of his materials are taken from three Atlantic coast states, and that he has still neglected important data relating to manufacturing in other sections of the country. Furthermore, although his results are labeled "General Indexes of

AN INDEX OF
NON-AGRICULTURAL EMPLOYMENT IN THE UNITED STATES
1902 TO 1917

E is the percentage which the volume of non-agricultural employment constituted of the normal supply of non-agricultural workers.
C is the deviation of E from the average of the series for that month.

Month	Average E	1902		1903		1904		1905		1906		1907		1908		1909	
		E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C
Average...	91	86	−5	91	0	89	−2	91	0	96	5	98	7	85	−6	91	0
January...	87	82	−5	87	0	86	−1	87	0	91	4	100	13	83	−4	85	−2
February..	88	83	−5	88	0	90	2	87	−1	92	4	100	12	84	−4	86	−2
March	89	85	−4	90	1	89	0	88	−1	94	5	101	12	84	−5	89	0
April.....	91	86	−5	92	1	89	−2	91	0	95	4	103	12	82	−9	91	0
May.....	91	85	−6	91	0	89	−2	90	−1	95	4	103	12	84	−7	92	1
June.....	91	85	−6	90	−1	88	−3	89	−2	94	3	102	11	85	−6	91	0
July.....	90	86	−4	90	0	86	−4	90	0	94	4	101	11	86	−4	91	1
August....	91	87	−4	91	0	87	−4	92	1	96	5	99	8	88	−3	91	0
September	93	88	−5	91	−2	90	−3	93	0	100	7	97	4	86	−7	94	1
October ...	94	91	−3	92	−2	91	−3	94	0	102	8	93	−1	87	−7	96	2
November	93	90	−3	93	0	89	−4	94	1	101	8	89	−4	87	−6	95	2
December .	91	89	−2	93	2	87	−4	93	2	101	10	85	−6	87	−4	94	3

[1] "Cycles of Employment and Unemployment in the United States, 1903–14," Vol. 18, pp. 227–40.

Month	Average E	1910		1911		1912		1913		1914		1915		1916		1917	
		E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C
Average...	91	93	2	89	−2	90	−1	91	0	84	− 7	84	−7	94	3	98	7
January...	87	90	3	88	1	87	0	88	1	84	− 3	77	−10	86	−1	94	7
February..	88	90	2	86	−2	86	−2	88	0	84	− 4	78	−10	87	−1	93	5
March.....	89	92	3	88	−1	88	−1	90	1	84	− 5	80	− 9	90	1	95	6
April.....	91	93	2	89	−2	89	−2	91	0	86	− 5	82	− 9	92	1	97	6
May.....	91	94	3	90	−1	90	−1	92	1	86	− 5	83	− 8	94	3	98	7
June.....	91	94	3	89	−2	90	−1	91	0	85	− 6	83	− 8	94	3	99	8
July.....	90	93	3	88	−2	90	0	91	1	83	− 7	83	− 7	94	4	98	8
August....	91	94	3	89	−2	91	0	91	0	83	− 8	84	− 7	96	5	98	7
September	93	96	3	91	−2	94	1	93	0	85	− 8	88	− 5	98	5	100	7
October...	94	96	2	92	−2	94	0	93	−1	85	− 9	89	− 5	99	5	102	8
November	93	94	1	91	−2	94	1	91	−2	83	−10	89	− 4	99	6	101	8
December..	91	92	1	89	−2	92	1	88	−3	81	−10	89	− 2	98	7	99	8

Unemployment in the United States," he has ignored practically all of the data relating to employment fluctuations in occupations other than manufacturing.

Other criticisms are unaffected by Mr. Berridge's second installment. His failure to take account of fluctuations in the available supply of labor, and the fact that his method is so complicated that the resulting index cannot be interpreted in common-sense terms, are serious defects. He is to be congratulated, however, upon his vigorous attack upon a vital problem, and upon having raised important questions of technique in unemployment statistics.

A reply by Dr. Berridge to Dr. Hart's criticism has been received by the Editor, but too late for publication in this issue. It will appear in the December number of the JOURNAL.

PHYSICAL MEASURES AS FUNCTIONS OF FREQUENCY DISTRIBUTIONS

BY M. C. RORTY

A point of view in connection with fundamental physical measurements which is of particular interest to the statistician arises from the very great probability that there are no absolute measures of extension, velocity, and time. Should this be the case, we are concerned, in physical mathematics, with measures which in every case must be derived from the things to be measured. If, for example, we are dealing with velocities, it is obvious that they can be measured only in relation to certain fundamental existing physical velocities. Similarly as to ex-

tension, the primary measure must be found with very great certainty in the dimensions of certain fundamental physical units.

For our present purposes it is not necessary to determine what these velocities and physical units may be. It is sufficient to know that somewhere in the physical scheme of things there must be elements of velocity and extension which are *the* most fundamental. Furthermore, with respect to such fundamental elements of velocity and extension, we can make only three assumptions: first, that all similar elements are of equal magnitude; second, that they have frequency distributions with definite modes; and third, that they have frequency distributions with no modes.

As to the preceding assumptions, it is hardly conceivable that independent elements, either of velocity or of extension, should all be equal in magnitude, in the absence of a previously existing measure by which they might be gaged. And it is almost equally difficult to conceive that they should be arranged in frequency distributions having definite modes, for the existence of such a mode would indicate a preference for some particular magnitude, which preference could hardly exhibit itself in the absence of any established standard of measurement.

If the foregoing reasoning is correct it follows that fundamental physical measures must arise out of frequency distributions having no definite modes. In such distributions the mean value is the natural measure, and the special characteristic of such distributions is that the maximum value is always almost exactly twice the mean.

To give this suggestion concrete form it may be assumed that the velocity of light represents the mean of certain primary velocities in space. On this basis the maximum primary velocity would be twice that of light. This conclusion is entirely concordant with the apparent limitation of material particles to a maximum velocity equal to that of light. In fact, there are reasons, which are, however, not pertinent to the present discussion, why material particles which are made up of a large number of ultimate primary particles should have maximum velocities nearly or exactly equal to the mean velocity of such primary particles.

An interesting feature of this approach to the problem of fundamental physical measurements is that it results in a division of physical elements into two classes. Pure time and space may be infinite, but the velocities and dimensions of material particles must be subject to measures arising out of the frequency distributions of the magnitudes involved. As to the latter, therefore, we are compelled to measure in terms of ratios. In such cases our ordinary notions of infinites become mere mathematical abstractions. The velocities of primary particles

may, in one sense, have a range from zero to infinity; but, if our only measure is one half of infinity, we will, for all practical purposes, assign a value of two to the limiting velocity.

A still more interesting corollary of the hypothesis here presented is that the physicist may know when he has discovered a fundamental physical element by observing whether or not it exhibits a range of magnitudes characterized by a frequency distribution without a mode.

ON THE CORRELATION BETWEEN A VARIABLE AND THE DEVIATION OF AN ASSOCIATED BUT NOT DEPENDENT VARIABLE FROM ITS PROBABLE VALUE

Let r_{xy} be the correlation between two variables, x, y, which are so related to each other physically that y may be considered a dependent variable in the special sense in which this term has been used heretofore. Pearson and I have shown[1] that

$$r_{xz} = \frac{r_{xy} - V_x/V_y}{\sqrt{1 - r_{xy}^2 + (r_{xy} - V_x/V_y)^2}}$$

where V denotes the coefficient of variation of x and y, and z is to be read as the deviation of y from its probable value, that is

$$z = y - px$$
$$p = \bar{y}/\bar{x}.$$

Now let x and y be associated with a third variable, say w. The correlations r_{wz}, r_{wy}, r_{xy}, r_{xz}, and the partial correlation ${}_wr_{xy}$ may be readily determined. In certain cases the correlation r_{wz} and the partial correlation ${}_wr_{xz}$ may be of service.

$\bar{z} = 0$; σ_z may be readily determined.[2] We require, therefore, merely the product moment for w and z. This might be determined by working directly with the individual values of the variable $z = y - px$. It is more convenient to proceed as follows:

Let $\Sigma(x)$, $\Sigma(y)$ denote the summation of the values of x and y for the n individuals of any class of w. Let S denote summation throughout the population or summation of the summations within the classes defined by the values of w.

Then within any class of n individuals defined by the value of w

$$\Sigma(z) = \Sigma(y) - p\Sigma(x).$$

For the whole series of $N = S(n)$ individuals

$$S(wz) = S[wS(z)] = S\left\{ w[\Sigma(y) - p\Sigma(x)] \right\}.$$

[1] Harris, "The correlation between a variable and the deviation of a dependent variable from its probable value," *Biometrika*, 6 : 438–443. 1909.

[2] Harris, "Further illustrations of the applicability of a coefficient measuring the correlation between a variable and the deviation of a dependent variable from its probable value," *Genetics*, 3 : 328–352. 1918.

Finally, remembering that $\bar{z}=0$ and expressing r in terms of product moments about 0 as origin.[1]

$$r_{wz}=\frac{S(wz)/N-\bar{w}\bar{z}}{\sigma_w\sigma_z}$$

and remembering that $\bar{z}=0$, we may write

$$r_{wz}\frac{S\{w[\Sigma(y)-p\Sigma(x)]\}/N}{\sigma_w\sigma_z}.$$

The means of arrays for testing the form of the regression curve of z on w are given by

$$[\Sigma(y)-p\Sigma(x)]/n.$$

J. Arthur Harris

CALCULATION OF THE CORRELATION RATIO

The correlation coefficient r is a good measure of correlation only when the regression is linear. It is necessary, therefore, before placing any reliance upon the computed r to examine the data for linearity of the regression lines. One common test of linearity, Blakeman's, compares the value of (η^2-r^2) with its probable error, η being a correlation ratio. In applying this test it is then necessary to calculate along with r the correlation ratios.

Recently the writer, with a number of assistants, among whom Mr. F. G. Wahlen should be mentioned, had occasion to compute several hundred correlation coefficients, each of which was tested by Blakeman's test. In the progress of the work, in which much use was made of the slide rule, there was developed the tabular form for the calculation of r with the two correlation ratios η_{yx} and η_{xy}, which is the content of this paper. By the addition of two columns to the tabular method of computing r used by Professor H. L. Rietz, the two correlation ratios are easily computed.

This method of calculating the correlation ratios in connection with the calculation of the correlation coefficient is shown in the accompanying numerical illustration. The various columns in connection with the correlation table explain themselves in the headings, with the exception of the columns headed $S_{s'}$ and S_s. The column headed $S_{s'}$ is computed as follows: Let s' be the number of any designated row of the correlation table, say the third row from the top. Then for that row each number is multiplied by the corresponding number in the column headed X. The algebraic sum of these products is $S_{s'}$. For example, for the third row from the top

$$\begin{aligned} 9\cdot(-1) &= -9 \\ 26\cdot 0 &= 0 \\ 7\cdot 1 &= 7 \\ 5\cdot 2 &= 10 \\ \hline & 8 = S_{s'} \text{ for } s'=3. \end{aligned}$$

The column headed S_s is computed in a similar way.

[1] Harris, "The arithmetic of the product moment method of calculating the coefficient of correlation." *Amer. Nat.*, 44 : 693–699. 1910.

A FORM FOR THE CALCULATION OF THE CORRELATION COEFFICIENT AND THE TWO CORRELATION RATIOS

Monthly pig iron tonnage	Monthly price index: 7.50 to 8.00	8.00 to 8.50	8.50 to 9.00	9.00 to 9.50	9.50 to 10.00	f_y	Y	$f_y \cdot Y$	$f_y Y^2$	S_s'	$S_s' \cdot Y$	$S_s'^2$	$\frac{S_s'^2}{f_y}$
28 to 32				4	4	8	3	24	72	12	36	144	18.00
24 to 28			4	16	1	21	2	42	84	18	36	324	15.43
20 to 24		9	26	7	5	47	1	47	47	8	8	64	1.36
16 to 20	8	21	14	3	1	47	0			−32		1024	21.79
12 to 16	10	8	2	2	1	23	−1	−23	23	−24	24	576	25.04
8 to 12	7	3				10	−2	−20	40	−17	34	289	28.90
f_x	25	41	46	32	12	156		70	266		138		110.52
X	−2	−1	0	1	2								
$f_x \cdot X$	−50	−41		32	24	−35							
$f_x \cdot X^2$	100	41		32	48	221							
S_s	−24	−5	32	49	18								
$S_s \cdot X$	48	5		49	36	138							
S_s^2	576	25	1024	2401	324								
$\frac{S_s^2}{f_x}$	23.04	0.61	22.26	75.03	27.00	147.94							

$$\bar{Y} = \frac{70}{156} = .4487$$

$$\sigma_y^2 = \frac{266}{156} - \bar{Y}^2 = 1.5038$$

$$\sigma_y = 1.2263$$

$$\bar{X} = \frac{-35}{156} = -.2244$$

$$\sigma_x^2 = \frac{221}{156} - \bar{X}^2 = 1.3663$$

$$\sigma_x = 1.1689$$

$$\frac{\Sigma X \cdot Y}{N} = \frac{138}{156} = .8846$$

$$r = \frac{1}{\sigma_x \sigma_y}\left\{\frac{\Sigma X \cdot Y}{N} - \bar{X} \cdot \bar{Y}\right\}$$

$$= .687 \pm .029$$

$$\frac{\Sigma \frac{S_s'^2}{f_y}}{N} = \frac{110.52}{156} = .7085$$

$$\eta^2_{xy} = \frac{1}{\sigma_x^2}\left\{\frac{\Sigma \frac{S_s'^2}{f_y}}{N} - \bar{X}^2\right\}$$

$$\eta_{xy} = .694 \pm .028$$

$$\frac{\Sigma \frac{S_s^2}{f_x}}{N} = \frac{147.94}{156} = .9483$$

$$\eta^2_{yx} = \frac{1}{\sigma_y^2}\left\{\frac{\Sigma \frac{S_s^2}{f_x}}{N} - \bar{Y}^2\right\}$$

$$\eta_{yx} = .705 \pm .027$$

The theory underlying this calculation of the correlation ratios follows from an algebraic transformation of the usual expression for the ratios. The correlation ratio of the y on x, usually represented by η_{yx}, is the ratio of the standard deviation of the means of the arrays of y's (columns), to the standard deviation of the y's. In the notation used in the illustration the mean of each column is given by $\frac{S_s}{f_x}$. The square of the standard deviation of the means of the columns is then

$$\frac{\Sigma f_x \left(\frac{S_s}{f_x} - \bar{Y}\right)^2}{N}$$

where N is the total number of entries in the table. From the above definition of the correlation ratio of y on x we have

$$\eta^2_{yx} = \frac{\Sigma f_x \left(\frac{S_s}{f_x} - \overline{Y}\right)^2}{N\sigma_y^2}.$$

This form can be reduced as follows:

$$\frac{\Sigma f_x \left(\frac{S_s}{f_x} - \overline{Y}\right)^2}{N\sigma_y^2} = \frac{\Sigma \frac{S_s^2}{f_x}}{N\sigma_y^2} - \frac{2\overline{Y}\Sigma S_s}{N\sigma_y^2} + \frac{\overline{Y}^2 \Sigma f_x}{N\sigma_y^2} = \frac{\Sigma \frac{S_s^2}{f_x}}{N\sigma_y^2} - \frac{\overline{Y}^2}{\sigma_y^2}$$

remembering that $\frac{\Sigma S_s}{N} = \overline{Y}$ and $\Sigma f_x = N$.

We may then write

$$\eta^2_{yx} = \frac{1}{\sigma_y^2}\left\{\Sigma \frac{\frac{S_s^2}{f_x}}{N} - \overline{Y}^2\right\}$$

and a similar transformation gives

$$\eta^2_{xy} = \frac{1}{\sigma_x^2}\left\{\Sigma \frac{\frac{S_{s'}^2}{f_y}}{N} - \overline{X}^2\right\},$$

both of which are easily obtained from the last columns in the form for computation.

A. R. Crathorne

University of Illinois

NEW SWEDISH PRICE INDEX NUMBERS

The Kommerskollegium of Sweden (Bureau of Commerce) has recently completed an official price investigation undertaken at the close of the war, and the results in the form of a new series of index numbers of Swedish wholesale prices appeared in the official publication of the Kommersiella Meddelanden for May 26, 1922.

The index numbers are built on 160 series of market quotations. Approximately 105 distinct commodities are included, representing raw products and manufactured goods in various stages of elaboration both for producers' and consumers' use. The classification comprises 13 main categories; vegetable food stuffs; animal food stuffs; feed and forage; fertilizers; raw and manufactured products of the iron and metal industries; mortar, brick, cement and glass; lumber; paper and pulp; textile fibres and fabrics; hides, leather, and shoes; rubber; chemical technical products. These main classes are again divided into subordinate commodity groups. Monthly indexes are computed for each series of quotations as well as for each subdivision and general group by taking a

weighted average of a percentage variation in prices. The weight used is the turnover value of the quantity marketed in 1913. The aggregate turnover value of all articles entering into the index amounts to two thirds of the total inland trade of Sweden that year. The indexes constructed for the commodity groups measure the fluctuation in monthly prices since January, 1920, in terms of the prices for the corresponding months of 1913; that is to say, January, 1921, prices are compared with the prices of January, 1913, and so on for each respective month. The field of this official inquiry is limited to wholesale prices from the beginning of 1920, and no effort has been made to cover the abnormal war period. Certain differences distinguish this index series from that of the *Svensk Handelstidning*, which reflects price movements by quarters from the beginning of the war to the end of 1917 and shows monthly fluctuations from 1918 to date. For the latter index the twelve months from July, 1913, to June, 1914, constitute the base period. The *Svensk Handelstidning* index, furthermore, is constructed from scantier material and is limited to only 47 market quotations of raw materials and slightly manufactured goods. It also weights the commodity according to value of consumption during the pre-war year instead of the value of trade turnover. In spite of these differences the degree of divergence between the two indexes is not particularly striking. The trend of movement is practically the same although the index of the Kommerskollegium is maintained consistently at a higher level.

The new price study of the Kommerskollegium is an interesting contribution to the literature of Swedish wholesale prices, especially since the compilers have published the original price material upon which the index is constructed, and have presented in detail precise market specifications of the commodities and the respective weights of all the articles included.

Another index number of current interest because of its usefulness in making international price comparisons has been compiled by the *Svensk Handelstidning* for the single month of February, 1922. The object of this publication in computing a new index was to analyze the value of the Swedish krona in relationship to other exchanges. Index numbers for the United States and England were compiled on the same basis as its own index for Sweden, using the same number and kind of commodities where possible. According to this computation the all-commodities indexes for Sweden and England are in very close agreement with each other, which points to the conclusion that, compared with 1913–14, the English pound sterling has lost approximately the same purchasing power as the Swedish krona. The index number of 132 obtained for the United States, on the other hand, gives a result widely divergent from the corresponding index of 166 for Sweden, indicating that the level of American prices in February was 34 points lower than the level of Swedish prices. As the margin is too wide to be accounted for by the slight differences in the comparability of the data, the conclusion drawn by the *Svensk Handelstidning* is that either Swedish price quotations must decline or the exchange value of the dollar rise.

RUTH E. K. PETERSON

Washington, D. C.

MISCELLANEOUS NOTES

Volume of Employment Figures. It will be of interest to statisticians to learn that Secretary Davis of the United States Department of Labor has recently made a ruling under which the Bureau of Labor Statistics is to have the field in the collection and publication of volume of employment figures, while the Employment Service is to collect and publish such information concerning the labor market and opportunities for employment as may be needed in the administration of its work, which is defined to be to get jobs for the jobless men.

With this jurisdictional conflict settled, Commissioner Ethelbert Stewart announces that it is the purpose of the Bureau of Labor Statistics to extend at once volume of employment data to cover several more industries and to expand greatly the number of establishments and, hence, the number of employees in the industries now included in the survey. State arrangements will be made wherever possible. An arrangement similar to that now existing between the United States Bureau of Labor Statistics and the state of New York has been practically completed with the state of Illinois, and other state agreements are under way. The Geological Survey will furnish information from the bituminous and anthracite coal mines, and the Bureau of Mines has expressed a willingness to supply similar information from the iron ore, copper, zinc, lead, silver and gold mines and from the smelting establishments. These will be individual establishment records. Railway transportation will be covered through the Interstate Commerce Commission. Immediately after the first of July the Bureau of Labor Statistics will put men in the field to form contacts with this enlarged list of establishments and industries and to complete state bureau arrangements wherever the states are willing to make a thorough canvass, and to establish a state record of volume of employment taken from the books of the establishments themselves.

It is the purpose of the Bureau to develop employment indexes by industries and a national index which will be a combination of all the industries covered. No attempt will be made to carry local indexes or indexes upon a basis of geographical areas, but assistance will be given to the states, where desired, in the compilation of state indexes from their local material. Commissioner Stewart further announces that the publication of this material will be continued as heretofore in the *Monthly Labor Review*, but that mimeographed statements of totals and indexes will be issued on or about the 5th of each month covering the payroll period as of the 15th of the preceding month.

Public Health in Denmark. In Danish history of public health the year 1921 is a record year, the rate of mortality being only 11 per 1,000. Out of a population of approximately 3,300,000 only 36,000 died. On the whole, public health in Denmark is standing very high. Even in the years 1918–19, when the "Spanish disease" reigned, the yearly rate of mortality was only 13 per 1,000. Danish statisticians boast that no other country has shown so low a death rate as that observed in Denmark in the past year. Still, our antipodes in New Zealand may claim a higher rank for their country, the rate of mortality

being on an average only 9–10 per 1,000, the influenza year, 1918, forming a single exception with its 15 per 1,000. It may be objected that this low rate is only a crude, not a "standardized," death rate, the low mortality being ascribed to the peculiar age distribution. Using the age distribution of Sweden as a standard we will find that New Zealand has an average mortality of about 12 per 1,000, and that the Commonwealth of Australia is a little above this level.

At all events, New Zealand has a remarkable advantage in its low infant mortality rate. Danish infant mortality is also low. In 1911–15 only 10 per cent of the new-born died within one year of age; in 1919–20 the number was reduced to 9 per cent, and in 1921, even to 7½ per cent. But in New Zealand infant mortality is on an average only 5 per cent, a fact which is ascribed to such matters as climate, virility of the race, comparative absence of large industrial undertakings, and partly to legislative and educative measures. There is much stimulation for all civilized nations in these observations. It seems possible to reduce infant mortality even more, for instance, to 3–4 per cent, the harvest of death being confined only to infants born with very delicate constitutions.

Denmark has a considerable *natural increase* of population, the excess of births over deaths being in yearly average about 12 per 1,000. Before the World War about one fourth of this excess, about 7,000 yearly, emigrated; but during and after the war emigration has been greatly reduced. Since 1880 about a quarter of a million have left Denmark as oversea emigrants, the majority of them founding their new homes in the United States of America.

HARALD WESTERGAARD

Bulletins of the U. S. Bureau of Labor Statistics. *Occupation Hazards and Diagnostic Signs*, by Louis I. Dublin, has just appeared as Bulletin No. 306. In this publication Dr. Dublin pushed forward the studies first launched in this country through Bulletin No. 100 of the Bureau, which contains a list of industrial poisons and other substances injurious to health found in industrial processes. Numerous attempts have since been made to restate this problem in simpler and more practical terms. For a long time the Bureau of Labor Statistics has been working upon a scheme to issue occupational disease handbooks which could be carried in the vest pockets of the workers, but so far the plan has not matured. In Bulletin No. 100, it will be remembered, the poison is made the unit, the branches of the industries in which the poison occurs is more or less adequately stated together with the mode of entrance into the body, and, finally, the symptoms of the poisoning. The Ohio Bureau two or three years ago revised and restated this information making the industry the unit and indicating what poisons were to be found in the industry, the mode of entrance into the body, etc. Dr. Dublin has published the guide to the hazards of occupations and the symptoms of the diseases they cause as issued to the 6,000 medical examiners of the Metropolitan Life Insurance Company, and in these instructions we find not only that the Metropolitan Life Insurance Company has gone beyond the mere list of poisons but has called attention to the health hazards from working conditions such as dampness, extreme dry heat, sudden variations

of temperature, and inorganic dust. It is a brief but very valuable contribution to the practical side of the subject.

The Problem of Dust Phthisis in the Granite-Stone Industry, by Frederick L. Hoffman, appears as Bulletin No. 293. This report is without doubt Dr. Hoffman's ablest, most thorough and comprehensive publication relating to a single industry.

Industrial Unemployment: A Statistical Study of Its Extent and Causes, by Ernest S. Bradford, will be issued as Bulletin No. 310. Dr. Bradford's volume will be a handy reference to sources of information and to information that has already been published.

Nordisk Statistisk Tidskrift. Under this title a new Scandinavian statistical journal has been founded by the Swedish statistician, Thor Anderson. It may be doubted whether twelve million Swedes, Norwegians, and Danes are a sufficient basis for a journal with such a comparatively narrow program; but the editor has very wisely procured as contributors renowned statisticians of other countries. Thus, in the first number of the journal appear very interesting articles by Professor Tschuprow and Professor L. v. Bortkiewicz. On the whole, this first number is very promising, dealing as it does with various important problems of practical and theoretical value. H. W.

Labor and Industry. This is the name of a new monthly publication issued by the Department of Labor and Industry of Pennsylvania. It is the official organ of the department and is edited by Mr. S. P. Hollingsworth. The publication contains reports of the activities of the various bureaus in the department and presents data collected from time to time concerning the status of labor and industry.

Public Health Work. A continuous series of canvasses is being made by field assistants of the Statistical Office, U. S. Public Health Service, of approximately 2,000 typical families in Hagerstown, Md., for the purpose of recording the incidence and prevalence of ill health in a representative population group for at least a year. The canvass was begun in November, 1921, and is being carried on in conjunction with the Washington County Health Demonstration, which is conducted under the auspices of the Johns Hopkins School of Hygiene and Public Health, the Maryland State Board of Health, and other agencies. The records for the canvassed population of between 8,000 and 9,000 persons include family economic status, home and community sanitary conditions, and nativity, sex, age, and other facts regarding each individual.

At the annual meeting of the American Association of Industrial Physicians and Surgeons held at St. Louis, May 22–23, a committee was appointed to cooperate with the Statistical Office of the U. S. Public Health Service in securing records in industrial plants of disabilities by cause among employees classified according to nativity, sex, age, and occupation, and according to physical status as determined by physical examinations. Dr. R. S. Quinby, of the Hood Rubber Company, Watertown, Mass., is chairman of the committee.

Committee on Educational and Professional Standards for Statisticians. This Committee, appointed by the Board of Directors of the Association in November, 1921, to consider educational and professional standards for statisticians, is preparing a preliminary report for the attention of the Association at its annual meeting next December. The Committee has been in correspondence with a number of representative statisticians here and abroad, and finds a general current of opinion in favor of a statement on educational fundamentals. In the preparation of the preliminary statement the opinion of these statisticians will be carefully considered.

Mr. Ethelbert Stewart, U. S. Commissioner of Labor Statistics, was invited by the University of Chicago to deliver a series of three lectures on how a great governmental statistical investigation is handled. Mr. Stewart delivered the lectures in May, describing step by step the methods and processes of a statistical investigation.

Dr. John Rice Miner, Associate in the Department of Biometry and Vital Statistics of the School of Hygiene at Johns Hopkins University, has been granted leave of absence for the next academic year, and will spend the time in study and travel abroad. During Dr. Miner's absence his position will be filled by Dr. Flora D. Sutton, who has for some time been connected with the Department in one capacity or another.

Dr. F. Stuart Chapin has resigned his position as Professor of Sociology at Smith College to become Professor of Sociology and Chairman of the Department of Sociology at the University of Minnesota. Dr. Chapin takes up his new duties in September.

Dr. F. H. Hankins, formerly Professor of Sociology at Clark University, has resigned his position at Clark to become Professor of Sociology and head of the department at Smith College.

Dr. Raymond Pearl's series of Lowell Lectures on Biology of Death will shortly be published in revised and extended form as a book, by the J. B. Lippincott Company in its series of Monographs in Experimental Biology.

Dr. Lowell J. Reid, Associate Professor of Biometry and Vital Statistics in the School of Hygiene and Public Health, Johns Hopkins University, has been appointed consultant in biometry and vital statistics in the U. S. Public Health Service.

Dr. H. R. Bonner, statistician of the Bureau of Education, Department of the Interior, Washington, D. C., has resigned his position to take up on September 1 the duties of Director of Educational Research with the American Alcohol Education Association.

Miss Margaret G. Myers, of the Statistical and Research Bureau of the Federal Reserve Bank of New York, was granted a leave of absence for the summer and taught in the Bryn Mawr Summer School.

Miss Katharine Snodgrass, who has recently resigned from the Division of Analysis and Research of the Federal Reserve Board, since their offices have been moved to Washington, has accepted a position with the newly organized statistics department of the Chemical National Bank.

In response to numerous requests, the Pollak Foundation for Economic Research has reprinted from the *Atlantic Monthly* for February, 1922, an article by Waddill Catchings entitled, "Our Common Enterprise: One Way Out for Labor and Capital." Copies may be obtained upon application to the Pollak Foundation, Newton 58, Massachusetts.

The President of the Association has appointed the Nominating Committee to nominate officers for 1923, to be considered and voted upon at the annual meeting in December, as follows: Carroll W. Doten, Chairman, Willford I. King, George P. Watkins.

MEMBERS ELECTED SINCE MAY

Alexander, Carter, Asst. director of the Educational Finance Inquiry, 525 W. 120th St., New York City

Arnold, Herbert E., Wesleyan University, Middletown, Conn.

Bedinger, George R., Director, Health Service Dept., American Red Cross, New York County Chapter, New York City

Blakely, David N., Medical director, New England Mutual Life Ins. Co., Boston, Mass.

Boyd, George A., Bell Telephone Securities Co., 195 Broadway, New York City

Bristow, Helen G., Sugar Statistics, Lamborn & Co., New York City

Brunner, Edmund de S., Director, Town and Country Dept., Committee on Social and Religious Surveys, New York City

Clark, Evans, Labor Bureau Inc., New York City

Cothran, James R., Consulting actuary, Atlanta, Ga.

Cox, Emily M., Sugar Statistics, Lamborn & Co., New York City

Craster, Charles Vaughn, Dept. of Health, Newark, N. J.

Dochterman, Elsie F., Statistical Dept., Metropolitan Life Ins. Co., New York City

Emerson, Haven, Professor of Public Health Administration, College of Physicians and Surgeons, Columbia University, New York City

Emmons, Lloyd C., Michigan Agricultural College, East Lansing, Mich.

Fried, Orrin A., Statistical Dept., Industrial Commission, Madison, Wis.

Frost, Eliott, Director, Industrial Management Council, Chamber of Commerce, Rochester, N. Y.

Gould, Charles W., Cost accountant, L. L. Brown Paper Co., Adams, Mass.

Hall, William DePuy, Actuarial Dept., Mutual Trust Life Ins. Co., Chicago, Ill.

Haynes, Williams, Publisher of *Drug & Chemical Markets*, New York City

Hemenway, Earl L., President's Office, Michigan Agricultural College, East Lansing, Mich.

Hendrick, Augustus C., 50 Buchanan Place, New York City

Jaquith, Walter A., Vice-president and medical director, National Life Ins. Co., Chicago, Ill.

Jacobs, Philip P., Publicity director, National Tuberculosis Ass'n, New York City

Kirk, Carl L., Asst. statistician, Zurich General Accident and Liability Ins. Co., Chicago, Ill.

Klein, Julius, Director, Bureau of Foreign and Domestic Commerce, Washington, D. C.

Koerner, Carl C., Statistician, Weyerhaeuser Sales Co., Spokane, Wash.

Lescohier, D. D., Dept. of Economics, University of Wisconsin, Madison, Wis.

Long, John C., Secretary, Educational Dept., National Automobile Chamber of Commerce, 366 Madison Ave., New York City

Lonigan, Mary E., Dept. of Labor, Albany, N. Y.

Loudon, Robert C., Curtice Brothers Co., Rochester, N. Y.

Luedtke, Charles L., Research and Foreign Statistics Section, Dept. of Agriculture, Washington, D. C.

Miller, Walter McNab, Executive secretary, Missouri Tuberculosis Ass'n, St. Louis, Mo.

Myers, Margaret G., Federal Reserve Bank, New York City

Nott, Richard A., American Tel. & Tel. Co., 195 Broadway, New York City

Pearson, Oscar P., Statistician, Nat'l Automobile Chamber of Commerce, 366 Madison Ave., New York City

Pranke, Edward J., Commercial Research, American Cyanamid Co., New York City

Redpath, John M., Manager, Research Dept., Chamber of Commerce of U. S., Mills Bldg., Washington, D. C.

Riddle, J. H., Chief, Section of Statistics, Treasury Dept., Washington, D. C.

Rogers, Homer L., Civil engineer, Conservancy Bldg., Dayton, Ohio

Rubins, Marian, Graduate student, University of Minnesota, Minneapolis, Minn.

Schafer, Irving J., Manager, Statistical Dept., Westinghouse Lamp Co., Bloomfield, N. J.

Smith, Donald B., Harvard Graduate School of Business Administration, Cambridge, Mass.

Smith, R. Gilman, Statistician, North American Co., New York City

Vose, Harold P., American International Corp., 120 Broadway, New York City

Warne, Frank J., Wage consultant, 302 Mills Bldg., Washington, D. C.

Watson, John C., Statistician, Illinois Agricultural Association, Chicago, Ill.

Will, H. S., Director, Bureau of Public Research and Service, Toledo University, Toledo, Ohio

Williams, Helen J., Lincoln National Life Ins. Co., Fort Wayne, Ind.

Wright, Francis A., Certified public accountant, 515 Republic Bldg., Kansas City, Mo.

REVIEWS

Costs, Merchandising Practices, Advertising and Sales in the Retail Distribution of Clothing, by Northwestern University School of Commerce Bureau of Business Research, Horace Secrist, Director. New York: Prentice-Hall, Inc. 1921. 6 vols. 622 pp.

Much information of value to the consumer, to the retail clothing merchant, and to the student concerning the items of expense and merchandising practices in the selling at retail of men's clothing is revealed in the six volume report of the Northwestern University School of Commerce Bureau of Business Research, of which Professor Horace Secrist is director. This is the first study to be published of the retail distribution of clothing.

The inquiry was made in coöperation with the National Association of Retail Clothiers and included the years 1914, 1918, and 1919. Questionnaires were sent to all of the members of the association and replies were received from 569 stores, about 10 per cent of the total association membership. Not all of these stores reported on all items included in the questionnaire, which covered in much detail all aspects of the retail clothing business except profits. To utilize to the utmost the data received, Professor Secrist has considered separately each portion of the questionnaire relating to a particular item. He has taken, for example, rent, and has tabulated the data from all stores reporting on this item regardless of whether or not they reported on other items in the schedule. Thus, 415 stores reported on total sales in 1919, although the number of stores giving information on other important items was somewhat less.

Analysis of the data for 1919 showed an average expense of $2.20 per $100 of net sales for rent; $11.93 for wages and salaries; $5.16 for "general expense," which included expenditures for light, heat and power, depreciation, local and state taxes (but not federal taxes), interest and borrowed money, bad debts charged off, etc.; $1.98 for advertising; and $21.49 for total expense.

The report is not confined to an analysis of cost information, but deals also with such matters as sales per unit of floor space, number and value of suits sold, sales of furnishings in proportion to clothing, returned goods and charge sales, purchases in relation to inventory, stock turnover, mediums of advertising used, and building and equipment of retail clothing stores.

The purpose of this inquiry was in the main a very practical one. The aim was to establish, for the guidance of retail clothing establishments, on the basis of the data collected, "standards of excellence by which merchants and others may know whether costs are excessive or merchandising practices sound." The question arises whether the statistical method employed in analyzing the data is the best one for the purposes of the study made. Is the standard or norm which is to serve as a guide for retail merchants to be the experience which is the most common, *i. e.*, the mode, or that of the most efficient operating establishment, or the arithmetical average of the stores reporting?

Professor Secrist has answered this question by placing all or practically all of the emphasis on the average in his statistical analysis. In the discussion of the item of rent, for example, there are 35 tables of which only two are frequency tables. Similarly, in the discussion of wage and salary expense there are 33 tables giving averages only, and but two frequency tables. In the summary discussion at the beginning of the volume relating to rent, wages and salaries, the discussion of conclusions is based wholly on the average figures. It is true that in the introduction the author calls attention to the value of other statistical devices in analyzing data. After stating that the data relating to amounts of expenditures and the relations which they bear to sales may be used in full confidence, Professor Secrist states that "this study . . . is a study of statistical frequencies with which given relations between items of expense and the conditions determining them are encountered. Such a method of study develops the average, the common and the extreme conditions which prevail."

The admirable method of study thus outlined is not, however, adhered to. Although the study includes 1918 and 1914 experience as well as 1919, the few frequency tables given in the discussion of rent, general expense, wages and salaries, and total expense refer only to 1919. There are no figures other than average figures given for either 1918 or 1914 concerning these items. Moreover, it is highly questionable whether the average figures for 1919 are representative of the data. Considering first the four main items of store expense—rent, wages and salaries, general expense, advertising—in no instance does the mode correspond to the average, and only in the case of one item, wages, does the average fall within the second largest group of frequencies. In the case of "total expense" the average reported is $21.49. Of the 399 stores reporting total expense in 1919, the total expense reported by 141 stores falls in the grouping $15 to $20, and 231 stores (59 per cent) report less than $20.

The figures for 1919 are as follows:

Item of expense	Number of stores reporting	Expense per $100 of net sales			
		Average	Mode	Second largest group of frequencies	Median
Rent	393	$2.20	94 at $1.00–$1.50	88 at $1.50–$2.00	220 under $2.00
Wages and salaries	378	11.93	103 at 7.50–10.00	90 at 10.00–12.50	261 under 12.50
General expense	351	5.16	69 at 3.00– 4.00	58 at 4.00– 5.00	216 under 5.00
Advertising	367	1.98	90 at .50– 1.00	85 at 1.00– 1.50	205 under 1.50
Total expense	399	21.49	141 at 15.00–20.00	93 at 20.00–25.00	231 under 20.00

In the summary to Volume III in the discussion of the item of total expense no mention is made except of average figures, and the discrepancy between the average figures and the common experience of retail clothing establishments is not noted. The comment on tables 81 and 82, which give the frequency distribution of stores reporting classified amounts of total expense per $100 of net sales, is as follows: "Table 81 is introduced to support the average figures shown in table 78. Just how accurate is the average total expense per hundred dollars

of total net sales for each of the group of stores as given in table 78, is revealed in the details of table 81." The entire discussion of the frequency table occupies less than half a page, and it is hardly probable that even the most enterprising retail merchant would disregard the conclusions of the conveniently placed summary and the ten pages of discussion placing emphasis on the average as the standard and substitute the different conclusions which would be made from an analysis of the frequency tables. The treatment of other frequency tables is similar to that of table 81.

In addition to compiling the average expense for various items from reports received from all stores reporting on that item for any particular year, Professor Secrist submits separately the average expense for identical stores which reported for all three years. In general, it may be stated that the averages for identical stores lead to the same conclusions as those based upon the figures for all stores from which reports were received. An error seems to have been made, however, in noting the number of stores reporting for 1914. For example, it is stated on page 107 that only 229 stores reported on rent for 1914. Yet on page 108 it is stated in table 3 that 268 identical stores reported on rent for all three years — 1914, 1918, and 1919. A similar error is made in the discussion of wages and salaries, general expense and advertising. The number of "identical stores" reporting for all three years is greater than the number of all the stores reporting similar data for 1914, although in the latter group are included stores reporting for 1914 but not for other years.

One very important matter not treated at all in the report is that of profit. In this as well as in other respects the report differs from the Harvard studies on retail businesses. However, it is possible in a general way to determine selling margins and profits from facts already made available by the Department of Commerce in its study of the Men's Clothing Industry in 1915, and from the data in the present report. In its report on the Men's Clothing Industry, the Department of Commerce tabulated the retail selling price and the wholesale price of some 144 suits of clothing manufactured by establishments under investigation. The relation between net wholesale price and retail price varied considerably in the case of various models. However, in the case of 79 out of the 144, the net wholesale price represented between 60 and 65 per cent of the retail price. The net wholesale price was less than 60 per cent of the retail price for 25 cases and in 40 instances over 65 per cent of the retail price. In more than two thirds of the cases falling within the group of 60 per cent but less than 65

RELATION OF NET WHOLESALE PRICE TO RETAIL PRICE OF MEN'S CLOTHING FEBRUARY, 1915

(Based upon the report of U. S. Department of Commerce, "The Men's Factory-Made Clothing Industry," Misc. Series No. 34, pp. 89–92)

Number of suit styles	Per cent the net wholesale price was of "usual retail price"
10	Under 57.5
15	57.5 but under 60
55	60 " " 62.5
24	62.5 " " 65
25	65.0 " " 67.5
15	67.5 or over
Total 144	

per cent the net wholesale price was less than 62½ per cent of the retail price. It might therefore be considered that in general the net wholesale price was approximately 62½ per cent of the retail price. The selling margin, then, early in 1915, was approximately 37½ per cent of the retail price.

When comparison is made between merchandising expense in 1914 and in 1919 it is observed at once that in 1919 every item of expense was lower than in 1914. In 1914 the total expense averaged $24.56 out of every $100 of net sales. In 1919 the average was $21.49.

AVERAGE EXPENSE PER $100 OF NET SALES FOR RENT, WAGES AND SALARIES, GENERAL EXPENSE, BUSHELING, ADVERTISING, TOTAL EXPENSE, 1919, 1918, 1914

Average	Rent	Wages and salaries	General expense	Busheling	Advertising	Total expense
1919	$2.20	$11.93	$5.16	$2.57	$1.98	$21.49
1918	2.89	13.14	5.85	2.77	2.04	23.69
1914	3.57	12.91	5.68	2.76	2.51	24.56

The mode for total expense in 1919 was between $15 and $20 per $100 of net sales. No figure is given for the most common experience for the total expense for 1914, but on the basis of the average figures for total expense and for each item of expense, it is clear that merchandising expense in 1919 was much less than in 1914 per $100 of net sales.

If we assume that the selling margin in 1914 was 37½ per cent and that the total expense was roughly 25 per cent on the average, the net profit was roughly 12½ per cent of net sales.

Selling margins during the year 1919 when prices were rising were undoubtedly fully as large as they were in 1914, yet much was said about the higher expenses of the retailers—rent, wages, general expense—as being at least in part the cause of higher prices. The figures of Professor Secrist, however, show distinctly that in every item of expense the proportionate cost of doing business was less in 1919 than it was in 1918 or in 1914. In fact, the cost of doing business in 1919 was less by 12½ per cent than it was in 1914. The effect upon net profits was undoubtedly even greater.

H. K. Herwitz

Prices and Wages; An Investigation of the Dynamic Forces in Social Economics, by Percy Wallis and Albert Wallis. London: P. S. King and Son. 1921. 449 pp.

The authors have devoted this large book to an attempt to prove a single economic proposition, namely, that the average price of commodities is determined by the labor time involved in their production relative to the labor time involved in the production of gold in which their price is measured. This theory is an old one and is the chief part of the Marxian doctrine, but the present book attempts an advance in two important respects, first, in offering a new ex-

planation of the means by which the employer abstracts from the price of goods the part which goes to capital and land; second, in the extent to which statistical data are relied upon for the confirmation of the theory. Both of these innovations are within the field of interest of the readers of this JOURNAL.

After an examination of the statistics of national income in the United States and England the authors conclude that 64 per cent of the total national income goes to labor. How do the employers manage to retain 36 per cent of the price of goods? The authors argue that the force which makes possible any subtraction for interest, capital, and employer's services is unemployment. If there were no unemployment the laborers would get it all; if all were unemployed the employers would get it all. If it be assumed that each percentage of unemployment gives an equal increase in the percentage of profit, it follows that the 64 per cent going to labor is the result of 36 per cent of unemployment. The statistics of unemployment do not admit, however, of the supposition that unemployment averages as much as 36 per cent, and the authors, therefore, reject the hypothesis that the division of the product is determined by a straight line between the points of no employment and no unemployment. From the available data they estimate that the average unemployment, allowing for part-time employment, in the United States and England is 12.5 per cent, and conclude that this amount of unemployment results in the division of product already indicated. A parabolic curve is drawn through this point (*i.e.*, 12.5 per cent unemployment and 64 per cent wages) and the points of origin, and it is contended that this curve gives the formula for the division of the product. It appears that if unemployment were 50 per cent, the employer would get 70.7 per cent of the product, but only, of course, 35.3 per cent of the possible maximum which would be produced if all were working. The employer would get the maximum in goods if unemployment were kept at 31 per cent, in which case he would get 38.4 per cent of the maximum product.

Is there any support for the view that the share going to labor fluctuates in such a manner as to conform in any degree to the curve here given, or even at all with unemployment? Certainly the figures for the distribution of national income are not available in the necessary serial form to compare with fluctuations in the unemployment rate. The authors do give some data as to changes in wages in certain English industries in periods of unemployment, which on the basis of the violent assumptions made bear some correspondence to the curve. It does not appear to have occurred to the authors that even a very marked relationship over a very limited part of the curve between unemployment and changes in the percentage going to labor and the employer would still leave the question open as to whether the present distribution is the result of unemployment. Against that hypothesis we have the outstanding fact that the percentage going to the laborer varies enormously from industry to industry. Certainly these variations bear no relationship to the amounts of unemployment in these industries.

If we turn now to the second attempted advance, namely, the proof by statistical data that labor time governs price, the outcome is equally disappointing. The authors have calculated for a number of commodities the "normal price"

for a series of years, "normal price" being defined as the number of articles produced per person multiplied by the money price. According to the labor-time theory the normal price would remain the same if there were no changes in the cost of gold. The proof of the theory would, therefore, consist in showing (1) that changes in the normal prices of different commodities were consilient and (2) that these changes were in agreement with the changes in the per capita output of gold. The authors have been able to find only a few commodities for which the normal price can be calculated, since the number of persons employed, the market price, and the number of units produced are necessary for the calculation. But the normal prices of coal have been calculated for several European countries. The correspondence in the fluctuations of these normal prices is marked, and all the curves show a gradual rise from 1860 to 1910. The fluctuations in general correspond, as might be expected, with changes in the ordinary index numbers of prices. The general rise in the normal prices of coal, which the authors make much of as indicating that the fall in general prices during the forty years from 1860 to 1902 shown by the ordinary index numbers of prices is erroneous, was due to the facts that wages rose in all European countries and that the per capita production of coal did not increase in anything like the same degree as that of manufactured commodities. When the authors approach the second and crucial question of the correspondence of the normal prices of these commodities with the quantity of gold produced per person, they are occupied chiefly in offering explanations of the failure of the normal value of gold to agree with the normal price of other commodities.

An enormous amount of labor has gone to the making of this book, and it is an ungrateful duty for a reviewer to have to say that in his opinion it has been wholly wasted.

GEORGE E. BARNETT

The Johns Hopkins University

Wealth and Income of the American People: A Survey of the Economic Consequences of the War, by Walter Renton Ingalls. York, Pa.: G. H. Merlin Company. 1922. xiv, 321 pp.

The main title of this book is likely to convey the idea that it parallels or duplicates the recent report of the National Bureau of Economic Research. That impression is erroneous. Though the author sometimes makes use of the material of the Bureau, his method and especially his purposes are different. In fact, the book contains a greater number and more general judgments and convictions than are quite appropriate for a statistical work. But the statistics used are, on the whole, dealt with critically and objectively. The author's economic opinions are less well considered, and indeed often appear to be hasty and cock-sure. Mr. Ingalls is an engineer.

The chapters of especial statistical interest are: II, "The Production of Commodities," 22 pages; III, "Wealth of the United States (the External Position)," 38 pages; and IV, "Wealth of the United States (the Internal Position)," 82 pages. The remaining chapters, though usually quantitative in thought, are

seldom statistical in content. The special feature of the method of the book is its inventory of the nation's capital so largely on the basis of corporate financial data.

Mr. Ingalls seeks to prove that the country was not better off in 1920 than in 1916. The thesis is worthy of careful consideration and practically important as a corrective of much unthinking self-deception of the public on this subject. If the statistics are not all that could be desired, and if quantitative conclusions are often rather forced, it is not so much the fault of the author as it is the lack of adequate data. It would be better if fuller or more exact references to sources had been given so that a later worker on the same subject might more easily rebuild and extend the statistical structure.

The author's most important conclusions may be summed up in his own words: "The physical volume of production during the eight years beginning with 1913 and ending with 1920 increased no more than commensurately with the increase in population" (p. 281). "From the end of 1916 to the end of 1920 the physical wealth of the United States increased from 268 billion dollars to 272 billion as an outside figure" (p. 282).

The attempt to avoid the effects of price inflation upon the estimates is entirely commendable. The writing-off of surplus plant is an interesting and important detail, even if, as done, it is open to criticism as perhaps being too drastic. Any statistician attempting to inventory our capital would greatly profit by following the figures and analysis presented in this book.

The author says in his preface: "An underlying thought in my work in this book is a repudiation of the quantitative theory of money" (p. viii). Since its advocates and opponents mean different things by this term, we cannot be quite sure from this statement what is meant. One who accepts the quantity theory can quite as readily agree with the author's numerical conclusions as one who does not. If a test is whether we are going back to pre-war prices, indications in the middle of 1922 are not the same as they appeared in the middle of 1921.

Remarks about the benefit to statistics of "the entry of professional men into this field" (p. 272 *et. seq.*) may be interpreted to mean that statistics are concrete, not abstract, numbers, and that the statistician cannot know too much about the facts underlying his figures.

The book is somewhat journalistic in tone, if the word may be used to imply no lack of industry and only some degree of lack of critical finish and proportion. Some of the conventional prejudices of the business world find uncalled-for expression. There is sometimes a lack of appreciation of developments that do not appear to be thoroughly understood—as of the theory of business cycles (p. 279) and of index numbers (p. 204). But the book is worthy of serious attention from statisticians and others interested in its subject.

G. P. Watkins

Washington, D. C.

Income in the United States, Its Amount and Distribution, 1909–19. By the Staff of the National Bureau of Economic Research, Incorporated: Wesley C. Mitchell, Willford I. King, Frederick R. Macauley, Oswald W. Knauth. New York: Harcourt, Brace and Company. 1921. xvi, 152 pp.

The worth of this little volume is two-fold. As a positive contribution it ranks with the best that American economic scholarship is producing. As an exhibit of scientific method it is an exhilerating stimulus to inductive investigation. The group of gifted young scholars—King, Macaulay, and Knauth—whom Professor Mitchell has gathered about him and infected with something of his own enthusiasm and fidelity, not only have shown what success can attend quantitative investigation into "subjects that affect public welfare," but have given new proof that economic knowledge proceeds by the hard road of laborious inquiry rather than by the alluring ease of speculative theorizing. It was by no accident that the preliminary report of one phase of the inquiry—Mr. Macaulay's paper read at the Pittsburgh meeting of American economists and statisticians—should have been accorded little short of an ovation by the company that heard it. Fine scholarship, painstaking toil, technical competence, literally hall-marked the performance, and the fraternity was prompt in acclaiming a *tour de force*.

Although it is this general quality of the essay, even more than its statistical technique or its positive contributions, that constitutes its chief appeal, the specific results are impressive. In the matter of the aggregate income of the American people, its variation from year to year and the causes of that variation, the division of the aggregate income among individuals, the proportions of the whole income going to wage earners and salaried employees, and the per capita income in the United States as compared with other countries, a base line has been drawn, perhaps not definitive, but certainly the necessary starting point for all succeeding discussion of these and related subjects. Pareto's "law" is interred, decently but with finality; the fact that there is a larger per capita income in the United States than in other countries is established, and the detailed distribution of personal incomes is reduced to a working statistical basis. A second volume, now in course of publication, will discuss the sources utilized and the methods employed, and it is proposed to continue the work of estimating the national income from year to year on a comparable basis as the necessary data become available.

Finally, something should be said as to the literary style and formal plan of the book. It is written in clear simple English, with a modesty in statement and a restraint in criticism that leave the edge undulled. As to arrangement, in its economy and directness it suggests nothing so much as the monition of a great teacher: "Have something to say, say it, sit down."

JACOB H. HOLLANDER

The Johns Hopkins University

Facing Old Age: A Study of Old Age Dependency in the United States and Old Age Pensions, by Abraham Epstein. New York: Alfred A. Knopf. 1922. 352 pp.

The author's first sentence reads as follows: "This book is, frankly, an appeal for social action." Following the foreword, in which he states that "our present methods in dealing with the aged are antiquated, inefficient, ineffective, costly and demoralizing," he presents arguments and a volume of reference material in support of the establishment of an old age pension system in the United States.

The book is divided into five parts and an appendix. The first part deals with the actual condition of the aged and pictures the modern industrial worker as in a very difficult position with respect to his approaching old age. Data are presented to show that the present unfavorable condition is becoming progressively more serious. The following quotations indicate that the author apparently has no sympathy with modern industrial and medical progress:

> Increased industrial efficiency, "scientific management," the "bonus system," and specialized and standardized production are forces which are increasingly using up human energy at greater speed and in a briefer period of life. Often, at the age when the worker in agricultural pursuits is considered to be in his prime, the industrial worker is found to have become worn out and old. . . . The lot of the aged and superannuated worker is thus adversely affected by practically every step of industrial progress; and little or no benefit is derived by old wage-earners from industrial improvements.
>
> . . . one cannot but wonder whether the fact that the aged population in the United States has increased from 3.5 per cent for those 65 years of age and upward in 1880 to 4.3 per cent in 1910, and that the expectation of life has improved, has been a desirable thing and is to be considered much of a blessing by the aged poor. Faced with conditions such as described above, and with the almshouse as the final destination of a life of destitution and drudgery, do they not look upon modern industrial development, as well as the advances made in medical progress and health as the creations of an evil spirit, which have, on the one hand, curtailed their period of production, and, on the other hand, prolonged their years of misery by the increased duration of life?

Part II of the book takes up the causes of old age dependency. Here the author first charges superannuation, dependency due to waning earning power, lack of family connections, sickness and industrial accidents as individual causes of dependency. He presents data compiled from various sources on sickness and accidents, and ends with the following charge against industrial efficiency:

> It is out of place to dwell here upon the tremendous price which is being paid annually in human and economic values in this country, largely as a sacrifice to greed and greater efficiency. . . . What this annual hecatomb means in terms of destitution and mental and physical suffering to the victims and their dependents permits no estimation.

The inadequacy of the wages paid to the wage-earner is presented next as an important cause of old age dependency, and he points out that "rarely is it taken into consideration by either party to the labor contract in modern society that the basis of the daily wage must make provision for such exigencies as sickness, accident, disability and old age." Finally, unemployment, strikes,

general misfortunes, and the part played by moral character are included in the causes of old age dependency.

Part III treats of existing methods of relief and presents a description of the various individual savings plans open to the wage-earner and of the various staff pension funds of industrial and governmental organizations. The author points out that the inadequancy of these plans is due to the facts that they have not been generally adopted, that many of those already adopted are subject to discontinuance at any time, and that many of them are financially unsound.

Part IV describes the purposes and nature of old age pensions and presents arguments for and against various methods of financing them. A history of the pension movement in this country is then given.

Part V describes the old age pension schemes and funds of other countries and of various states of this country, including approximately thirty different plans.

Although no specific outline of a general old age pension plan is recommended in the book, the appendix includes the draft of a bill introduced in the United States Congress to provide old age pensions, and the draft of a bill proposed by the Pennsylvania Commission, of which the author was director, and introduced in the Pennsylvania legislature in 1921.

The bill presented to the Pennsylvania legislature provides for the creation of a State Old Age Assistance Board consisting of three members appointed by the governor. This board is to appoint a State Old Age Assistance Superintendent, who is to be provided with assistants. In each county of the state a county board of three citizens, appointed by the governor (with the approval of the state board) on the recommendation of the county commissioners, is also provided for. County boards may appoint local investigators and make recommendations to the state board. An old age pension is to be fixed in each case by the state board, but in no case shall it exceed $25 a month. To qualify for a pension the applicant must be a citizen of the United States, he must have attained the age of sixty-five and have been a resident of Pennsylvania for 15 continuous years immediately preceding his application, or for 35 years followed by 5 continuous years immediately preceding his application. He must not be an inmate of any jail, asylum, poorhouse or similar public institution, he must not have an income in excess of $300 a year, nor property valued in excess of $5000, and he must not have a child financially able to support him. The applicant whose claim is approved receives a certificate showing the amount of his pension, which certificate is subject to cancellation or change in the event of a change in the applicant's income. On the death of the applicant any amounts paid under the certificate, with 3 per cent interest, are deductible from his property and refundable to the state. If he has no property the state pays burial expenses not exceeding $100. No reserves are created, no contributions are required, no actuarial estimates or checks are provided. The entire cost of the pensions is to be provided by the Commonwealth of Pennsylvania. The administrative expenses of the state board are to be paid by the state, and the expenses of the county boards by the counties.

The author pleads guilty to a certain bias in connection with his presentation

of the subject, but he attempts to present the material regarding the various systems of old age pensions impartially. He has endeavored to give such a complete presentation of the workers' condition and has drawn upon so many sources that the data included must be used with care; otherwise the reader will find some disagreement between the arguments and the figures presented. It is to be regretted that the author does not present any estimates of the probable future cost of the various types of old age pension plans. In view of the difficulties that are confronting so many pension schemes which have been established without proper regard to cost, it would seem that the relative costs of the various old age pension plans proposed should receive careful consideration before laws are placed on the statute books.

GEORGE B. BUCK

Index Numbers of Wholesale Prices in the United States and Foreign Countries. U. S. Department of Labor, Bureau of Labor Statistics. Bulletin No. 284 (revision of Bulletin No. 173). October, 1921. 350 pp.

The monograph on index numbers of wholesale prices, prepared under the direction of Dr. W. C. Mitchell and first published in July, 1915, is so well known to all who have occasion to use or to analyze index numbers or to construct new ones that any review which concerns itself with the contents of the original study would be entirely unnecessary. In the present edition, Part I, entitled, "The Making and Use of Index Numbers," has been revised, and Part II, on "Index Numbers of Wholesale Prices," has been brought down more nearly to date. These changes, however, have not introduced any material modification of the content or method of the earlier bulletin. There have been included in this edition the index numbers prepared by the Federal Reserve Board, which were begun subsequent to the original publication of the monograph, and some of the more recent work on the index numbers of foreign countries. Doubtless for some good and sufficient reason no reference has been made to certain of the inquiries into index numbers or to a good deal of index number discussion that has been in progress abroad since the close of the war. The earlier monograph was already so thorough in its method that it has not been necessary to make very far-reaching changes. The most important change is perhaps a more extensive mathematical treatment of certain of the phases of index number computation. This no doubt is of large interest to the more technical student of the index number problem, particularly in so far as discussion is offered of the war price literature.

In Part II where the various existing index numbers are reviewed, nothing materially new is given, but what is furnished is brought down sufficiently close to date to make the monograph once more the most complete and available handbook on the subject that is within reach of the student. In the present edition a few of the more important new index numbers are discussed in addition to the ones covered in the original study. Since many of those in the earlier study have long been discontinued, however, it would seem that greater service might have been rendered if some of these had been eliminated and others which are in very general use at the present time had been included.

It is to be regretted that this most recent volume does not undertake to enter the field of recent international price discussion or to review the various methods that have been developed in the last few years for comparing the prices of different countries whose currencies are not upon the same metallic basis.

H. Parker Willis

Columbia University

Immigration and Labor, by Isaac A. Hourwich. New York: B. W. Huebsch, Inc. Second Edition, Revised, 1922. xxxii, 574 pp.

The first edition of *Immigration and Labor* appeared in 1912. It followed the publication of the report of the Immigration Commission, appointed in 1907, which had unanimously recommended some form of restriction of immigration. Dr. Hourwich's work was principally an attempt to refute the conclusions of the Commission. For this purpose he was indefatigable in the collection of statistics and insisted that the problems connected with immigration had to be viewed in the light of the concrete facts rather than of abstract theory or mere prejudice. The first edition met with severe criticism at the hands of two competent reviewers, Professor Fairchild and Dr. Foerster, whose principal fire was directed against Dr. Hourwich's unscientific and injudicious, not to say deliberately misleading, use of the statistical method.

The main body of the present revised edition is, with the exception of a few minor changes, the same as the first edition. The text is the same, and no more recent statistics have been added. This edition, however, contains an additional chapter on "The Lessons of the War," and in the appendix there is a section in answer to Professor Fairchild and Dr. Foerster, the critics of the first edition.

With the strictures of Dr. Hourwich's critics upon his employment of the statistical method, the present reviewer finds himself in cordial agreement. Again and again the author assumes that what is *cum hoc* or *post hoc* is also *propter hoc*. If wages are higher in certain states having large immigration than in others having a small number of foreign-born, or if wages are higher in cities with their large proportion of foreign-born than in rural districts with small foreign-born population, it is proved, concludes the author, that immigration has no harmful effect upon wages. Or again, if the ratio of trade union membership to urban population is greater in New York than in Kansas although the former state has a far larger proportion of foreign-born in its population, it is proved that immigration is not an obstacle to the organization of labor. The author seems to be unconscious of the fact that other factors besides immigration may possibly affect wage rates or the organization of labor.

Dr. Hourwich maintains that our experience during the World War, when immigration was reduced to a very low level, was a vindication of his contentions concerning the effect of immigration upon wages. The war period was one of increasing physical volume of production and of enlarged profits for employers. Here was the opportunity, he says, to determine by actual experiment the effect of restriction of immigration upon wages. What was the outcome? He points out that wage statistics are in an unsatisfactory state and that there are con-

flicting opinions concerning the course of real wages during the war, but he considers that the principal evidence shows a decline. He concludes that "if restriction of immigration is to become the permanent policy of the United States, our recent war experience does not warrant the assumption that the resulting scarcity of labor will inure to the benefit of the American wage worker." Dr. Hourwich should also have stated, however, that this same experience does not disprove the assumption. It is in just such a problem as this that statistical investigation must be supplemented by economic analysis. Only upon the assumption that everything but immigration remained the same would it be justifiable to conclude that the statistical showing of the movement of real wages during the war disproved the theory that restriction of immigration would inure to the benefit of the American wage worker. There were changes in too many factors besides immigration, however, to warrant such a conclusion. Consider, for instance, the change in the value of our monetary standard due to inflation of currency and credit. It is well known that at such times increases in money wages tend to lag behind those in prices of commodities, which would mean an increase in profits at the expense of real wages. Bear in mind also the fact that the country was waging a war involving expenditures of gigantic proportions, and that all that was spent for guns, munitions, aeroplanes, battleships, and for the replacement of torpedoed merchant vessels, was so much withdrawn from the real income and real wages of the nation. Total production may have increased, as the statistics of Day and Stewart quoted by Dr. Hourwich seem to indicate; but a large proportion of this production, consumed in the waging of war, was of no avail toward augmenting the real wages of workers, in the sense of goods and services for their own consumption. Hence decreases in real wages were to be expected both because of changes in distribution and because of the probable decrease in the total product available for distribution. The fact, then, that the decrease in wages happened to come at the same time as a restricted volume of immigration proves nothing as to the causal relations between the two.

It is Dr. Hourwich's professed purpose to treat the problem of immigration from the economic viewpoint. But, as a matter of fact, he never gets at the heart of the economics of immigration. That problem involves the following questions: (1) Has the population of this country reached such a point that its natural resources are employed to the best advantage, and that further increases in population must mean working under less and less advantageous conditions as regards natural resources, with a consequent decline in the marginal productivity of labor? (2) Regardless of the answer to the above question, does increased immigration mean an unbalanced growth in our population, that is, such an enlargement of the group of unskilled laborers as to increase the inequality in the distribution of wealth and to hinder the process of abolishing poverty? (3) Granted that the immigrants may be better off in this country than in their old homes and also that the upper classes of native-born workers may reap certain material benefits through the presence of a plentiful supply of cheap unskilled labor, is it still true that the continuing existence of a large group of underpaid, poorly housed, insufficiently nourished human beings constitutes a sore spot in the body politic, encouraging ill-considered demands for sweeping changes in our

economic system while the fundamental cause of the poverty of the unskilled, namely, the excessive number of them, is ignored? Looked at in this way the question of immigration involves a probing of the very foundations of economic science, an analysis, on the one hand, of the relationship between population and natural resources and, on the other hand, of the whole problem of distribution. Such an analysis Dr. Hourwich did not attempt. If he had, he must have been more circumspect in the drawing of conclusions from the statistics which he gathered.

WILLIAM O. WEYFORTH

The Johns Hopkins University

The Census and Some of Its Uses: Outlining a Plain Philosophy of Population, by George T. Bisset-Smith. Edinburgh: W. Green & Son, Ltd. 1921. 228 pp.

The title of this book seems to promise three things: some account of the census, mention of some of its uses, and an outline of a plain philosophy of population. One may logically, therefore, consider the content of the book with reference to these three subjects, although the arrangement of the material is such that it would be difficult to segregate and bring together those portions which relate to any one topic. To be sure, the book is divided into three parts, but in subject matter the parts do not apparently differ from one another; and as for the chapters, it would seem as if almost any accidental order would be just as logical as that in which they appear. One reason for this formal defect may be found in the fact that the book is in part a reproduction of articles upon various aspects of the census which the author "had contributed to the press from time to time in his limited leisure." It seems fairly evident that many such articles have been reproduced as chapters without any alterations.

On the subject of the English census the book contains considerable information. Having been for many years connected with the Department of the Registrar General for Scotland the author is familiar with census taking in Great Britain. There are only casual references to the census in other countries. The British Census Act of 1920 is given in an appendix, the census questions are discussed in different connections, and some of the difficulties of census taking are dwelt upon. But there is no connected or complete account of the organization and machinery of census taking, and hardly any reference to the tabulation and presentation of the census data.

As a census man I have frequently thought that the uses of the census presented an important and timely subject which has not received adequate treatment. The public, I am afraid, is inclined to be sceptical. So when I received this book I took it up eagerly, believing that here the uses of the census, or at least some of them, would be convincingly set forth; but the author has hardly more than touched upon that subject. Yet the uses of the census are neither few nor unimportant.

The "plain philosophy of population" is equally hard to find and formulate. Under such titles as "industry and socialism," "unemployment," "fertility of

marriage," "Bolshevism," and "German militarism," the author expresses his views regarding many social and economic questions. He dissents emphatically from the doctrine that population increases faster than subsistence. Having faith in the "illimitable power of human invention and resource," he denounces the doctrine of over population as a bogey raised by Malthus, and repeatedly declares that "no country can continue powerful without a progressive population." This would seem to be the fundamental tenet in his philosophy of population.

The most valuable and interesting portions of this book, as already intimated, are those which relate to the English census; and the author might have forestalled criticism to some extent if he had adopted some title less pretentious and more appropriate, such as "Informal Talks on the Census and Other Subjects."

J. A. HILL

The Economics of Petroleum, by Joseph E. Pogue. New York: John Wiley & Sons, 1921. 375 pp.

Mr. Joseph E. Pogue's latest book, "The Economics of Petroleum," deserves appraisal from three points of view.

It merits a place as a source book in the neglected field of the economics of production and marketing. The author does not deal with labor problems; his only reference to labor is labor cost. He has little or nothing to say of monopoly, combination, regulation, or the Sherman and Clayton acts, and he makes only incidental reference to finance, investment and profits. He places emphasis rather on the supply and demand for petroleum and its multiple products; on the commercial interaction of oil and the other fuels; and on the machinery of production, transportation, and marketing. His analysis of these subjects is able and comprehensive. It is a study of the kind that we need to develop a theory of production.

To the executives of the petroleum business the book should have an even stronger appeal. It is the first comprehensive picture of the industry that combines a consideration of engineering and economics. The analysis is dynamic rather than static. It searches for trends and finds many of them—trends of markets, of prices, of reserves and demand. American petroleum is considered in its relation to the world supply, and oil is viewed as in competition with coal, oil shale, gas, and water power. The market for by-products and the competitive pressure of substitutes are examined. Changes in the future supply of motor fuel are correlated with necessary changes in the engines that use it. The basic material on these varied topics the author has selected from many sources and has examined critically in the light of his own experience as geologist and consulting engineer. To cover so wide a field requires boldness in interpreting and in projecting trends, and the technicians will doubtless take exception to some of Mr. Pogue's conclusions; but it is just this courageous projecting of tendencies that business needs in a troubled time like the present, and the fuel industry owes Mr. Pogue a debt of thanks for undertaking it. Probably no other man in the country could do the job so well.

The book is also interesting because of its statistical technique. Text, tabular

matter, and diagrams are woven into an organic whole. To economize the attention of the reader, quantities are expressed in large units—millions of barrels, thousands of dollars, etc.—not only in the text itself but also in formal tables. How many of Mr. Pogue's readers will correctly interpret the logarithmic charts that he uses to show rates of change may be open to question; but he has taken every precaution to prevent misunderstanding, including an ingenious marginal "sale of increase or decrease." Indeed, the standard of execution of all the diagrams is high, and there are many of them. As a presentation of quantitative data the book is notably successful.

F. G. Tryon

U. S. Geological Survey

History of the Great War Based on Official Documents. Medical Service General History, Volume I. London: His Majesty's Stationary Office. 1921. 463 pp.

This is the first of four volumes on the general history of the British medical service, and is a part of the series giving a more detailed history of the war from the medical and surgical standpoints. This volume relates in narrative form the chief features of the medical service from 1914 to 1918 in the United Kingdom in garrison overseas and with expeditionary forces. The other three volumes of the series will deal with the medical service in France, Italy, the Mediterranean area, Mesopotamia, Aden, East Africa, and Russia.

There is a brief summary of the growth of the Royal Army Medical Corps before the World War, and its subsequent expansion. An account of the training of the medical staff, its duties, administration, and the handling of supplies and equipment from 1914 through demobilization is given in detail. It is pointed out that the medical service expanded rather by accretion than by preconceived plan. There is a brief summary of the medical service in West and Southwest Africa and in Tsingtau. There is also a full account of some of the more important problems which the R. A. M. C. encountered, especially in reference to the medical examination of recruits, the sanitary arrangements for billeting, and the demobilization of the doctors. This impartial explanation answers the criticism which was so common during the war and which arose from the failure to understand the problems involved. The reader of the volume will get an intelligent grasp of the problems connected with the R. A. M. C.; and for those who wish to go into greater detail there are tables and summaries in the Appendix giving information relative to the quantity of supplies and equipment and of the accommodations for the wounded.

Margaret Gantt Stephens

A First Course in Statistics, by D. Caradog Jones. London: G. Bell & Sons, Ltd. 1921. 286 pp.

This book is adapted for use as a text by students who have previously covered an elementary treatise on the subject. True, it begins with a review of fundamental principles, but the treatment is so brief and the discussion so meager that it is not well suited to beginners in the field.

The weak side of this work is that it analyzes only in an incomplete way many of the reasons for the adoption of certain processes or methods. In this respect it is sharply contrasted with Armand Julin's recent work on *Principes de Statistique Théorique et Appliquée*. The strong feature of the book under review is that it gives a rather simple and, in some cases, an exceptionally well worked out presentation of the methods involved in such processes as correlation, sampling, and curve fitting. The volume will doubtless prove to be one of the best available texts in statistics for students who have mastered elementary calculus and have a mathematical turn of mind.

WILLFORD I. KING

RECENT LITERATURE

STATISTICAL BOOKS

Carr-Saunders, A. M. The population problem. A study in human evolution. Oxford, the Clarendon Press, 1922. 516 pp.

Davies, G. R. Introduction to economic statistics. New York, The Century Co., 1922. vi, 163 pp.

Ingalls, Walter R. Wealth and income of the American people; a survey of the economic consequences of the war. York, Pa., G. H. Merlin Co., 1922. xiv, 321 pp.

Jacquart, Camille. La population et la guerre. Conférence faite à l'Institut Supérieur de Philosophie le 15 février 1922. Louvain, Institut Supérieur de Philosophie, 1922. 34 pp.

Lavington, F. The trade cycle; an account of the causes producing rhythmical changes in the activity of business. London, P. S. King and Son, 1922. 113 pp.

Maurette, Fernand. Les grands marchés des matières premières. Paris, Librairie Armand Colin, 1922. vi, 198 pp.

National Industrial Conference Board. Changes in the cost of living. July, 1914–March, 1922. New York, The Century Co., 1922. viii, 33 pp. (Research Report. No. 49)

—— The cost of living among wage earners. Anthracite region of Pennsylvania, February, 1922. New York, 1922 (Special Report. No. 21)

—— Experience with works councils in the United States. New York, The Century Co., 1922. vi, 191 pp. (Research Report. No. 50)

—— The International Labor Organization of the League of Nations. New York, The Century Co., 1922. vi, 159 pp. (Research Report. No. 48)

—— Railroad wages and working rules. New York, The Century Co., 1922. viii, 130 pp. (Research Report. No. 46)

—— Wages and hours in anthracite mining. June, 1914–October, 1921, inclusive. New York, The Century Co., 1922. vii, 67 pp. (Research Report. No. 47)

Odate, Gyoju. Japan's financial relations with the United States. New York, Longmans, Green and Co., 1922. 136 pp. (Columbia University Studies in History, Economics and Public Law. Whole No. 224)

Stamp, Sir Josiah. Wealth and taxable capacity. The Newmarch lectures for 1920–21 on current statistical problems in wealth and industry. London, P. S. King and Son, 1922. 195 pp.

UNITED STATES GOVERNMENT PUBLICATIONS

New York State

New York (State) Department of Labor. New York labor laws enacted in 1922. Albany, 1922. 38 pp.

—— —— Women in industry. Albany, 1922. 40 pp.

United States

United States. Bureau of the Census. Animal and vegetable fats and oils; production, consumption, imports, exports and stocks by quarters, calendar years 1919, 1920 and 1921. Washington, 1922. 16 pp.

—— —— Birth statistics for the birth registration area of the United States, 1920. 6th annual report. Washington, 1922. 257 pp.

—— —— Cotton production in the United States: crop of 1921. Washington, 1922. 35 pp.

—— —— Fourteenth census of the United States. Bulletins.

Agriculture: Summary of the census of agriculture for the United States. 1919 and 1920. 76 pp.

Drainage: Illinois, Indiana, Michigan, Minnesota, Ohio.

Irrigation: 1919 and 1920: United States.

Manufactures, 1919: Connecticut, Maine, Oregon, Tennessee, Washington, Agricultural implements.

Population: Occupations. Dwellings and families.

—— —— United States life tables, 1890, 1901, 1910, and 1901–10. Explanatory text, mathematical theory, computations, graphs, and original statistics; also tables of United States life annuities; life tables of foreign countries; mortality tables of life insurance companies. Prepared by J. W. Glover. Washington, 1921. 496 pp.

—— Children's Bureau. Publications. No. 98. Child labor and the work of mothers in oyster and shrimp canning communities on the Gulf Coast, by V. I. Paradise. 114 pp. No. 102. Children of wage-earning mothers; a study of a selected group in Chicago, by H. R. Wright. 92 pp.

—— Bureau of Education. Bulletins.

1921. No. 51. Statistics of nurse training schools 1919–20. 19 pp.

No. 53. Statistics of state universities and state colleges, for the year ended June 30, 1921. 14 pp.

1922. No. 4. Statistics of private commercial and business schools, 1919–20. 11 pp.

—— Bureau of Labor Statistics. Bulletins. No. 290. Decisions of courts and opinions affecting labor 1919–20, by L. D. Clark and M. C. Frincke. 477 pp.

No. 297. Wages and hours of labor in the petroleum industry, 1920. 153 pp.

No. 301. Comparison of workmen's compensation insurance and administration, by C. Hookstadt. 194 pp.

No. 303. Use of federal power in the settlement of railway labor disputes, by C. C. Fisher. 121 pp.

No. 306. Occupation hazards and diagnostic signs. A guide to impairments to be looked for in hazardous occupations, by L. I. Dublin and P. Leiboff. 31 pp.

ARTICLES IN PERIODICALS

Casualty Actuarial Society. Proceedings. November, 1921. A. H. Mowbray: Competition and regulation of rates for casualty insurance. J. H. Woodward: Industrial retirement systems based on the money-purchase principle. A. L. Kirkpatrick: The development of public liability insurance rates for automobiles. W. Leslie: Distribution of surplus by casualty companies writing participating insurance. A. H. Mowbray: Classification of risks as the basis of insurance rate making with special reference to workmen's compensation insurance.

L'Economista. March 19–May 28, 1922.

March 26. F. Savorgnan: La potenza d'acquisto della moneta all'interno e all'estero.

May 7. Le materie prime. R. Bachi: La vita economica nel biennio 1920–21.

May 14. R. Bachi: La vita economica nel biennio 1920–21.

May 21–28. Numero e specie degli Istituti per l'istruzione media per il complesso del Regno

Federal Reserve Bulletin. April–May, 1922.

April. Interdistrict gold movement. Tobacco finance. Argentine foreign trade statistics.

May. Foreign exchange operations, 1918–19.

June. The gold and silver situation. Credit insurance.

Giornale degli Economisti. March, May, 1922.

March. G. Sensini: "Beneficii" del produttore. E. Corbino: Il protexionismo marittimo in Italia. M. Boldrini: A proposito di domanda ed offerta del cotone.

May, G. del Vecchio: Sciopero dei contribuenti? V. Porri: Il gettito dei dazi doganali e la struttura tecnica del tributo. G. Carano-Dovinto: Il movimento sindacale.

Giornale di Matematica finanziaria. March, 1922. F. Insolera: Considerazioni generali sulla teoria dell ammortamento. C. E. Bonferroni: Sull 'interpolazione nelle tavole finanziarie. S. Minetola: La misura delle grandezze ed il problema delle prove ripetute nel calcolo delle probabilità.

Industrial Bulletin. March, 1922. Factory building increases. Farm labor much cheaper.

Journal of accountancy. May–June, 1922.

May. E. L. Suffern: Municipal accounting in New Jersey. L. Perkins: Plant accounts in invested capital. L. H. Ruden: Steamship ticket and money-forwarding agents' accounts. A. A. Piper: Accounts of cotton hosiery manufacturers.

June. J. H. Jackson: Treatment of redemption funds. J. R. Wildman: Training young accountants.

Journal of the Institute of Actuaries. March, 1922. E. H. Leaver: An investigation into the mortality experienced by life tenants under reversions, with some conclusions drawn therefrom. S. J. Perry: On the relation between the course of wholesale prices of commodities and the market value of various classes of securities. H. L. Trachtenberg: Another method of valuing policies in groups.

Journal of the Institute of Bankers. April–May, 1922.

April. E. Sykes: Mr. R. G. Hawtrey on the efficacy of the rate of discount. J. Brunton: The law of set-off.

May. L. Le M. Minty: American methods of recruiting, and training and promoting bank personnel. Unemployment insurance: The bankers' special scheme.

Metropolitan Life Insurance Co. Statistical Bulletin. April–May, 1922.

April. Smallpox record of American and Canadian cities in 1921. Declining death rate among negroes. Large increase in recent months in mortality from organic diseases. Typhoid fever in American cities, 1921.

May. Increasing life span in the United States, 1901–20. Excessive accident fatalities in the United States. The suppression of rural typhoid fever. The occupation factor in accident mortality.

Monthly Labor Review. May, 1922. Wages and hours of labor in anthracite coal mining in Pennsylvania in January, 1922. Ta Chen: Shipping strike in Hongkong. Methods of determining the cost of living.

Le Musée Social. March–May, 1922.

March. M. Catroux: Le mandat dans l'état de Damas. Un chapitre de l'oeuvre économique et sociale de la France en Syrie.

April. M. Huot: L'oeuvre sociale de la France au Maroc. Politique de protectorat.

May. M. Blondel: La crise sociale et économique de l'Angleterre.

Public Health. April–May, 1922.

April. C. R. Gibson: Variations in vital statistics of adjoining districts. S. G. Moore: Five years' experience of the notification of pregnancy.

Public Health Reports. Volume 37. Nos. 14–23. April–June, 1922. No. 15. J. J. Sippy: A study of infant and maternal death rates in a western state. Mortality from typhoid fever, 1920. No. 16. T. Clark and E. Bell: Correcting physical defects in school children. A study of the results of the correction of certain physical defects on the growth and development of weight of 146 school children in Baltimore, Md. Physical defects among 8,887 underweight school children. Vaccination histories of smallpox cases, 1921. No. 18. H. I. Huntington: Health work in a model village. Second annual report of the Department of Health, Perry Point, Md. Federal allotments to states for coöperative venereal disease work. No. 20. T. Clark, E. Sydenstricker and S. D. Collins: Heights and weights of school children. A study of the heights and weights of 11,335 native white school children in Maryland, Va., and North and South Carolina. No. 22. F. E. Leslie: The delinquent. No. 23. The notifiable diseases. Prevalence during 1921 in cities of over 100,000.

Quarterly Journal of Economics. May, 1922. J. W. Angell: International trade under inconvertible paper. L. Kotany: A theory of profit and interest. F. H. Knight: Ethics and the economic interpretation. J. H. Williams: German foreign trade and the reparation payments. W. F. Doane: Cole's "The domestic and foreign wool manufacturers and the tariff problem." A. P. Usher: The genesis of modern capitalism. J. S. Davis: Index numbers of foreign exchange.

Review of Economic Statistics. April, 1922. W. M. Persons: Review of the first quarter of the year. J. S. Davis: Recent developments in world finance. Supplement: Statistical record: 1921. Monthly data, edited by E. E. Day.

Revue d'Économie Politique. March–April, 1922. S. Zagorsky: Le famine russe et ses causes. Ch. Bodin: Contribution aux théories du capital et du revenu. P. Struve: Prix-valeur. Énoncés fondamentaux. B. Lavergne: L'essor des coopératives de consommateurs en France depuis 1913. L. Baudin: La liquidation de la crise et la question des réparations d'après les banquiers anglais. La crise et la Bourse.

OTHER BOOKS

Bonnett, Clarence E. Employers' associations in the United States; a study of typical associations. New York, The Macmillan Co., 1922. xviii, 594 pp.

Mueller, Henry R. The Whig party in Pennsylvania. New York, Longmans, Green and Co., 1922. 271 pp. (Columbia University Studies in History, Economics and Public Law. Whole No. 230.)